VOLUME 18 / NUMBER 15
AUGUST 8, 1980
ACC. NOS. N80-24259 TO N80-25273

STAR
AN ABSTRACT JOURNAL

Scientific and Technical Aerospace Reports

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Scientific and Technical Aerospace Reports, Volume 18, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Informatics Information Systems Company.

The Administrator of the National Aeronautics and Space Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1981.

US ISSN 0036-8741

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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

Each major division is further divided into as many as nine specific categories, which are identified by category numbers.

Abstracts in *STAR* are grouped by specific category, the categories appearing in sequential order. Category breaks in the abstract section are identified by the category number and title, and a scope note. Cross-references to other categories are provided as appropriate. For example:

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*.

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For related information see also *Astronautics*.

01 AERONAUTICS (GENERAL) 1931

02 AERODYNAMICS 1931

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*.

03 AIR TRANSPORTATION AND SAFETY 1934

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION 1935

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command and Tracking* and *32 Communications*.

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE 1936

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

06 AIRCRAFT INSTRUMENTATION 1939

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

07 AIRCRAFT PROPULSION AND POWER 1939

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

08 AIRCRAFT STABILITY AND CONTROL 1941

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

09 RESEARCH AND SUPPORT FACILITIES (AIR) 1943

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*.

12 ASTRONAUTICS (GENERAL) N.A.

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13 ASTRODYNAMICS 1944

Includes powered and free-flight trajectories; and orbit and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) 1944

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air)*.

15 LAUNCH VEHICLES AND SPACE VEHICLES 1944

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

16 SPACE TRANSPORTATION 1946

Includes passenger and cargo space transportation, e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING 1946

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE N.A.

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

19 SPACECRAFT INSTRUMENTATION 1947

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

20 SPACECRAFT PROPULSION AND POWER 1947

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

23 CHEMISTRY AND MATERIALS (GENERAL) 1948

Includes biochemistry and organic chemistry.

24 COMPOSITE MATERIALS 1948

Includes laminates.

25 INORGANIC AND PHYSICAL CHEMISTRY 1951

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

26 METALLIC MATERIALS 1955

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 1959

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

28 PROPELLANTS AND FUELS 1962

Includes rocket propellants, igniters, and oxidizers; storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power*, *20 Spacecraft Propulsion and Power*, and *44 Energy Production and Conversion*.

ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

For related information see also *Physics*.

31 ENGINEERING (GENERAL) 1968

Includes vacuum technology; control engineering; display engineering; and cryogenics.

32 COMMUNICATIONS 1968

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking*.

33 ELECTRONICS AND ELECTRICAL ENGINEERING 1974

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

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34 FLUID MECHANICS AND HEAT TRANSFER 1978

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For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

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Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

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37 MECHANICAL ENGINEERING 1985

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY 1987

Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS 1988

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

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Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

For related information see also *Space Sciences*.

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For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation*.

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83 ECONOMICS AND COST ANALYSIS 2067
Includes cost effectiveness studies.

84 LAW AND POLITICAL SCIENCE N.A.
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 2068
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences*.

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 2069
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 2070
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION N.A.
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

92 SOLAR PHYSICS 2075
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 2077
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

GENERAL

99 GENERAL 2077

Note: N.A. means that no abstracts were assigned to this category for this issue.

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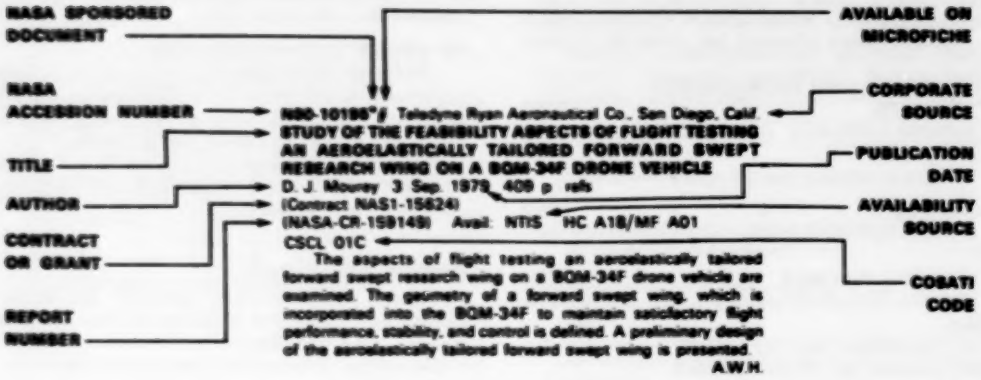
TYPICAL CITATION AND ABSTRACT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AVAILABLE ON MICROFICHE
NASA ACCESSION NUMBER
N80-10198*# Teledyne Ryan Aeronautical Co., San Diego, Calif.
CORPORATE SOURCE
TITLE
STUDY OF THE FEASIBILITY ASPECTS OF FLIGHT TESTING AN AEROELASTICALLY TAILORED FORWARD SWEPT RESEARCH WING ON A BQM-34F DRONE VEHICLE
PUBLICATION DATE
AUTHOR
D. J. Mourey 3 Sep. 1979 409 p refs
AVAILABILITY SOURCE
CONTRACT OR GRANT
(Contract NAS1-15824)
REPORT NUMBER
(NASA-CR-159149) Avail: NTIS HC A18/MF A01
CSCL 01C
COSATI CODE
The aspects of flight testing an aeroelastically tailored forward swept research wing on a BQM-34F drone vehicle are examined. The geometry of a forward swept wing, which is incorporated into the BQM-34F to maintain satisfactory flight performance, stability, and control is defined. A preliminary design of the aeroelastically tailored forward swept wing is presented.
A.W.H.

ON-GOING RESEARCH PROJECTS

This is a listing of research projects - not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, VARIABLE LOAD E/A CONCEPT

S.P. Desjardins, Simula Inc., *2223 S. 48th St., Tempe, Arizona* 85282 (DN081113; N62269-79-C-0241)

To investigate the feasibility of improving the operational performance of energy attenuator systems in crashworthy seats by incorporating a passively controlled variable limit load concept in their design. This contract supports work unit ZA601, Agency Accession No. DN681080.

A prototype variable limit load energy attenuator device will be designed, fabricated, tested and evaluated. Various load control mechanisms will be included in the evaluation.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate

1.0002, EFFECT OF FREE-STREAM TURBULENCE AND SURFACE ROUGHNESS ON BOUNDARY-LAYER TRANSITION

J.M. Kendall, U.S. National Aeronautics & Space Admin., Jet Propulsion Lab., *4800 Oak Grove Dr., Pasadena, California* 91103 (DF144080)

Designs of advanced aerospace vehicles require a better understanding of boundary-layer transition. Although many transition experiments have been conducted in past years, the phenomenon of boundary-layer transition remains poorly understood. The objective of this work is to provide experimental information which will enable application of stability theory to the prediction and interpretation of boundary-layer transition. Fundamental experiments such as these will provide new knowledge on the nature of transition and a more reliable means of predicting boundary-layer transition.

Through wind tunnel experiments the turbulence interaction efficiency throughout the important range of wave number and obliquity angle will be measured directly, using a new approach. The interaction results will be represented analytically and combined with stability theory to form a transition prediction method. Mean velocity profiles on a model with distributed roughness will be measured and represented analytically for the computation of stability results.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0003, ADVANCED ELECTRONIC FLIGHT CONTROL SYSTEMS DEVELOPMENT (INTEGRATED SENSORY SUBSYSTEM)

W.D. Weinstein, Grumman Aerospace Corp., *S. Oyster Bay Rd., Bethpage, New York* 11714 (DN081106; N62269-79-C-0206)

To develop an integrated and survivable configuration of inertial and air data flight control sensors suitable for digital flight control systems. This contract supports work unit ZA601, Agency Accession No. DN681080.

Synthesize and evaluate the operational capabilities of ISS integrated sensory subsystems and develop the asset advanced skewed sensory electronic triad accelerometer configurations.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate

1.0004, BICONIC AERODYNAMICS

D.S. Gillies, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF142900)

This work unit supports a SAMSO technology need for updated information on biconic reentry vehicles as well as tests planned at the AEDC wind tunnels on biconic designs. Biconic reentry vehicles would provide significant packaging and weight advantages over present sphere-cone designs. Technology on stability of biconics at reentry conditions will be advanced with completion of this study. The objective of this effort is to determine the aerodynamic properties of biconic configurations as a function of geometry for various angles of attack for reentry Mach and Reynolds number environments. This reentry environment simulation will improve ICBM capabilities and performance with the new design data and criteria obtained and will allow prediction of aerodynamic centers to within one percent of the vehicle length at reentry conditions.

Comprehensive experimental test program in the AFFDL 20-inch hypersonic wind tunnel varying biconic geometry and angles of attack over ICBM reentry Mach and Reynolds number conditions. Accompanying analysis to establish methods for accurate prediction of aerodynamic coefficients.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0005, DEPLOYABLE STABILIZATION AND RESTRAINT DEVICES FOR EJECTION SEATS

S.R. Mehaffie, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF144090)

This work unit will support the emergency escape and recovery of Air Force crew members from fighter aircraft. Current ejection seats are aerodynamically unstable, resulting in crew member injuries due to unrestrained limb flail and uncontrolled aerodynamic forces. The objective of this work effort is to determine the feasibility of deploying stabilizing surfaces on the ejection seat such as a nose and tail fairing. Additionally, an advanced crew member restraint system will be examined in order to control the limb flail problem. Successful demonstration of this concept will result in a capability for rapidly deploying pre-shaped crew escape system appendages which have potential for achieving the ejection seat stabilization and crew member restraint necessary to prevent serious injury or loss of life of the crew member during emergency escape.

The seat geometry is to be altered by the deployment of pre-shaped, foam-filled bags to act as nose, tail and advanced crew member restraint. This approach requires the development of a foam deployment technique capable of attaining fifty-millisecond operating time.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0006, PRELIMINARY DESIGN OF AIRCRAFT STRUCTURES
R.S. Sandhu, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF143760)

To reduce the acquisition and maintenance costs and to insure a high degree of structural integrity and reliability of future Air Force weapon systems, it is imperative to develop reliable lightweight and low-cost airframe structures. The objective of this program is to develop new, low-cost structural concepts for Air Force weapons systems, and to enhance the capability of the preliminary design group in the areas of design-analysis techniques for the design and the evaluation of these concepts using advanced materials.

New structural concepts and arrangements using metallic, composites and hybrid materials will be designed, fabricated, and validated by tests resulting in an improved structural technology base.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0007, IMPROVED DATA MANAGEMENT SYSTEM
R.B. Philbrick, Bell Helicopter Textron, *Hwy. 183, P.O. Box 482, Fort Worth, Texas* 76101 (DA0E3867; DAAJ51 79 C 0015)

Develop an improved data analysis and management system known as DATA-MAP (data from aeromechanics' tests and analytics-management and analysis package, formerly known as OLS-DMS) to be used for interactive analysis and display of data resulting from flight, wind tunnel, or whirl tower tests, and for validation and evaluation of analytical methods. An end-result will be the capacity to analyze and display data for improving performance, stability and control, loads and vibrations, acoustics and aeroelastic stability.

Improve DATA-MAP (OLS-DMS version 2.01) by expanding and enhancing its graphics, analysis and operational capabilities in order to increase its versatility and usefulness as an engineering tool. A data file will be defined to simplify conversion of data formats and structures for input to DATA-MAP,. thus facilitating direct comparison of test and simulation results and also providing for C-81 data display and analysis.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0008, INTEGRAL THEORY OF IMPACT ANALYSIS
T. McDonough, U.S. Dept. of Defense, Defense Advanced Research Projects Agency, *1400 Wilson Blvd., Arlington, Virginia* 22209 (DF142980)

In the performance of many military missions the crew compartment transparent enclosure is exposed to various different threats. It is imperative that the crew compartment enclosure (windshield, canopy) provides maximum protection against ballistic threats. This program will analytically analyze transparencies for resistance to ballistic impacts and will determine design methodology to maximize transparencies for survivability against ballistic threats while minimizing the associated costs, weights, thicknesses, etc. By obtaining a capability to analytically determine an optimum windshield design, instead of the current cut and try techniques, the assets required to arrive at a final windshield design should be substantially reduced.

Aeronautical Research Associates of Princeton (ARAP) has developed an integral theory of impact which offers the potential capability to predict material response to ballistic threats. ARAP will predict the ballistic limit of an existing multi-laminate aircraft windshield. If the theory proves successful, ARAP will then design a windshield specimen optimized for performance against a ballistic threat while remaining within specified weight, cost and thickness parameters. That windshield specimen will then be fabricated and tested and if acceptable levels of correlation are obtained, remaining funds will be used to develop the theory to handle additional variables (yaw, obliquity and projectile shapes).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0009, AN ADAPTIVE CONTROLLER FOR AN AIRCRAFT GAS TURBINE PROPULSION SYSTEM
R.G. Leonard, Virginia Polytechnic Inst. & State University, Graduate School, *Blacksburg, Virginia* 24061 (NSG 3275)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, INVESTIGATION OF THE CNTD MECHANISM AND PROPERTIES OF SIC AND ALN DEPOSITION
R.A. Holzl, Chemetel Corp., *Pacoima, California* 91331 (DF054420; F49620-79-C-0041)

AF function - ceramic materials are being developed for a variety of components (e.g., blades, vanes, combustors, bearings and seals) in future gas turbine engines and for a variety of electronic and optical components in aircraft. Opportunity - a new CVD-like process known as CNTD (controlled nucleation thermochemical deposition) has been developed for producing very fine-grained materials having superior mechanical properties. Objective - the objective of this research is to study the mechanism and deposition parameters of CNTD for fine-grained high strength silicon carbide and aluminum nitride. How work contributes - silicon carbide deposits will be further evaluated by the Air Force for strength, toughness and corrosion resistance for possible impact on the Ceramic Turbine Engine Program. Silicon nitride samples will be further characterized for optical, dielectric and thermal properties under concurrent AFOSR research contracts.

The optimum deposition parameters for CNTD will be established to produce fine-grain, high strength SiC and AlN. Microstructure and mechanical testing data will be used in an iterative development cycle for optimizing the process. Variables to be studied include gas chemistry, gas pre-heat, gas flow, partial and total pressure, substrate temperature, methods of heating and geometry of the sample and deposition system.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0002, ENERGY TRANSFER PROCESSES AND COHERENCE IN CONDENSED PHASE
C.B. Harris, University of California, Berkeley Campus, School of Letters & Science, Dept. of Chemistry, *Berkeley, California* 94720 (CHE77-14667 A01)

Dr. Harris will investigate the properties of solids and liquids which are important and responsible for rapid electronic and vibrational energy transfer in condensed phases. He will develop new experimental approaches to the field utilizing the coherent properties of applied magnetic (microwave) and electric (laser) fields. In addition, he will develop the theoretical basis for the investigations. This theory is applicable in a general way to many different types of spectroscopy. Finally, he will investigate the interrelationships between kinetic and statistical descriptions of energy transfer in condensed phases. This research represents a continuation of that currently supported by Foundation grant CHE-7420707.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0003, TITANIUM COATING IGNITION TEST
Unknown, United Technologies Corp., Pratt & Whitney Aircraft Group, *P.O. Box 2691, West Palm Beach, Florida* 33402 (DF463340; F33615-79-C-2005)

To verify the effectiveness of titanium fire suppressant coatings developed in a materials technology program.

Test coated samples of titanium in a flow field of varying temperature, pressure and velocity. Samples will be ignited by melt impingement and/or high energy laser.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

3.0004, WEAPONRY - COMBUSTION OF NON-ALUMINIZED HETEROGENEOUS SOLID PROPELLANTS

W.C. Strahle, Georgia Inst. of Technology, School of Aerospace Engineering, Dept. of Aerospace Engineering, *Atlanta, Georgia* 30332 (DN223680; N00014-75-C-0332)

The objective of this work is to obtain quantitative understanding of the combustion of ammonium perchlorate--binder--ammonium perchlorate (AP) sandwich models in an effort to establish a predictive capability for the burn rate behavior of composite propellants. The research, hopefully, will contribute fundamental kinetic data on binder and oxidizer decomposition, and gas-phase, catalytic, and interface reactions all pertinent to cost-reduction aspects of propellant formulation and development for Navy missiles.

The investigation is aimed at acquisition of experimental data relevant to combustion of AP-binder sandwiches incorporating catalysts within the binder, oxidizer, or at the interface and extension of an analytical model to include several effects of importance. A combustion bomb, with burning up to 3200 psi, will be utilized with deflagration characteristics inferred through cinephotomicrography and quenched sample photomicrography.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0005, HIGH DOSE ION IMPLANTATION OF ALUMINUM AND TITANIUM ALLOYS

J.R. Stevenson, Georgia Inst. of Technology, School of Physics, *225 North Ave. N.W., Atlanta, Georgia* 30332 (DF054110; AFOSR-79-0011)

AF function - corrosion due to the formation of oxides and nitrides limits the life-span of equipment and is both economically and militarily expensive. Deficiency - unexpected and catastrophic failure of metal components can occur where corrosion damage is undetected. Objective - to make beneficial changes to the surface chemical and physical properties by the use of ion implantation techniques. How work contributes - ion implantation is expected to improve such surface properties as hardness, friction, resistance to oxidation and corrosion without changing the bulk properties of structural metal alloys.

Ion implantation is a technique which has evolved from electronic device fabrication. This research project will explore the possibilities of improving the mechanical, chemical and metallurgical surface properties by utilizing high doses (up to 10 to the 19th power ions incident per sq. cm of target area).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0006, CHEMICAL APPLICATIONS OF RESONANCE RAMAN SPECTROSCOPY WITH TUNABLE LASERS

R.P. Van Duyne, Northwestern University, Evanston Campus, School of Arts & Sciences, Dept. of Chemistry, *633 Clark St., Evanston, Illinois* 60201 (CHE78-00877)

Dr. Van Duyne is studying the electronic structure of the ground and the excited states of radical ions as well as the nature of highly exothermic, nonadiabatic electron transfer reactions. In addition he is pursuing a series of investigations into the development of highly specific molecular probes for the monitoring of electrochemical processes and for the analytical characterization of low dimensionality, organic solids possessing unusual electronic properties. The main experimental technique being employed is resonance Raman spectroscopy (RRS). Tunable continuous wave (CW) as well as pulsed dye lasers are being used as the primary excitation sources. This work is a continuation of that currently supported by Foundation Grant, CHE-7412573.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0007, LONG RANGE MOLECULES

W.C. Stwalley, University of Iowa, School of Liberal Arts, Dept. of Chemistry, *Jessup Hall, Iowa City, Iowa* 52240 (CHE77-14681 A02)

Dr. Stwalley will investigate long range molecules, i.e., molecules (mainly diatomic) in their highest closely spaced vibrational-rotational levels near dissociation. These molecules have unique and exotic properties which, however, are often simply related to the long range behavior of the interaction potential (e.g., -C6R-6). The existence of such molecules has been conclusively established by electronic spectroscopy and independently by theoretical calculation. This research will involve spectroscopic studies (e.g., using a high-resolution tunable laser) principally of diatomic Li-containing molecules (e.g., the A1 sigma plus u state of Li2 where nearly half the vibrational states are predicted to be long range) with complementary theoretical studies as appropriate.

This research represents a continuation of that currently supported by Foundation grant CHE-74-13019.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0008, HIGH TEMPERATURE TURBINE ROTOR MATERIAL

Unknown, General Electric Co., *1000 Western Ave., West Lynn, Massachusetts* 01910 (DF463780; F33615-79-C-2043)

Investigate the use of carbon/carbon material in the turbine rotor of a small (500 to 1000 pounds thrust), 50-hour-life turbofan engine. The rotor will operate at 2500 degrees F and will not require any cooling air.

The basic contract will be a design study of a turbine rotor in a 2500 degrees F tit of a small turbofan and will also include a carbon/carbon material definition effort. Possible follow-on efforts include design, fabrication and test of a carbon/carbon turbine rotor.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

3.0009, SURFACE EFFECTS IN THE PLASTICITY OF CRYSTALLINE SOLIDS

R.M. Latanision, Massachusetts Inst. of Technology, School of Engineering, Dept. of Metallurgy & Materials Science, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (DMR78-05935)

It is known that the mechanical behavior of a solid may be affected by conditions at its surface. In the case of semiconductors and insulators, the influence of variations in the space charge distribution on the mobility of dislocations has been proposed as an explanation for mechanical effects. The principal objective of the present program is to study the effect of changes in the space charge distribution on dislocation mobility about hardness impressions in cadmium sulfide surfaces exposed to sub-band-gap illumination in order to achieve the flat-band condition as determined by surface photovoltage spectroscopy. A singular feature of this program, particularly with respect to the role of surface charge, is the introduction of a surface analytical approach into an area that has been studied historically by essentially metallurgical methods. The microhardness and dislocation mobility (by etch putting techniques) will be determined for a variety of surface conditions. In addition the effect of adsorbed gases on surface mechanical behavior will be studied. Theoretical calculations of the forces between adjacent, like-charged dislocations will be performed to aid in the interpretation of experimental results.

This is a continuation of studies initiated under NSF grant DMR76-06854.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

3.0010, ENERGY PARTITIONING AND FLOW IN METAL-OXIDANT FLAMES

R.W. Field, Massachusetts Inst. of Technology, School of Science, Dept. of Chemistry, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (CHE78-18427)

This research is in the area of quantum chemistry. Dr. Field plans to carry out a three-faceted investigation of energy flow in alkaline earth plus oxidant flames. Its purpose is to de-

lineate and explain the most important channels for transfer of internal energy between electronic and chemical species. Particular attention will be focussed on the role of isolated-molecule spin-orbit and rotation-electronic perturbations in facilitating transfer of population between electron states. The three parts of this study are: (1) complete characterization of all so-called 'reservoir levels', as well as several high lying radiating states, by the technique of Optical-Optical Double Resonance (OODR) Spectroscopy; (2) detailed experimental and computer analysis of perturbations with the dual purpose of mapping the possible perturbation channels into, between, and out of the reservoir levels and establishment of quantitative relationships between populations and laser-induced fluorescence intensities; (3) selective pulsed preparation of individual reservoir levels by the technique of Stimulated Emission Pumping, combined with fluorescence and excitation spectroscopic population monitoring, to obtain state-to-state transfer rates and quantum efficiencies. This research represents a continuation of that currently supported by Foundation grant CHE7505959.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0011, EFFECT OF MOLECULAR STRUCTURE ON MESOMORPHIC BEHAVIOR

A.C. Griffin, University of Southern Mississippi, School of Science & Technology, Dept. of Chemistry, *Hattiesburg, Mississippi* 39401 (DMR7805284)

Liquid crystals can flow like liquids, but have some of the molecular ordering of solids. The changes of this ordering and of the optical properties with temperature or applied field are the basis of using liquid crystals in, say, the familiar digital thermometers or display devices. The goal of Professor Griffin's work is to examine how the tendency of the liquid crystal phases to undergo transitions is affected by such chemical attributes of the constituent molecules as dipole interactions, polarity, size, and ability to hydrogen bond. The long range goal of this work is to enable the synthetic chemist to tailor make a system with desired transition temperature and optical properties. A correlation between molecular structure (electronic and steric factors) and smectic properties is to be established by preparing and examining binary mesophase systems. New smectic materials are synthesized as required. Experimental studies include (1) microscopic measurements of transition temperatures and phase identification; (2) thermal measurements of heats and temperatures of transition for selected pure compounds and binary systems using differential scanning calorimetry; (3) X-ray studies of structure when required by the uniqueness of the binary behavior.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

3.0012, LIGHT SCATTERING EFFECTS FOR AEROSOLS AND OTHER PARTICLE SYSTEMS

M. Kerker, Clarkson College of Technology, School of Science, Dept. of Chemistry, *51 Main St., Potsdam, New York* 13676 (CHE77-13102)

This project will study a number of new light scattering effects, and the application of these effects to study the size, composition and internal structure of particulate systems. Examples are aerosols, hydrosols, and biological cells.

When Raman or fluorescent scattering signals are used to probe for molecular species in aerosols or biological cells, significant errors will occur unless the effect of particle size and shape is considered. Numerical and experimental studies will be carried out to elucidate the effect quantitatively.

When light is absorbed by a particle, the particle may be heated. The effect of this heating on particle motion will be studied. Configurations of particles which have abnormally low scattering cross-sections (nearly invisible particles) have been discovered. Similar effects for absorbing particles will be investigated.

An integral equation formulation to permit effective calculation of scattering from particles with internal structure will be developed.

This research is a continuation of that currently supported by Foundation Grant, CHE-7403910.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0013, PHASE RELATIONS AND ELECTRON-ELECTRON INTERACTIONS IN THE SYSTEM LITHIUM-METHYLAMINE

M.J. Sienko, Cornell University, Ithaca Campus, School of Arts & Sciences, Dept. of Chemistry, *Ithaca, New York* 14850 (CHE78-12238)

This research project is in the area of chemical thermodynamics, in the subfield of phase equilibria. The system lithium-methylamine will be examined for its electric, magnetic, and magnetic resonance behavior over the concentration range from 0 to 30 moles percent metal, and over the temperature range from 4 degrees K to 300 degrees K. Special attention will be given to the region of the metal-nonmetal transition, and its relation to liquid-liquid coexistence, and 'expanded-metal' compound formation. Electron spin resonance, electrical conductivity, nuclear magnetic resonance, and X-ray and neutron diffraction are among the experimental methods which will be applied. The results will be of interest for the analysis of electron-electron interactions and the metal-insulator transition, especially for disordered systems.

This research is a continuation of that currently supported by Foundation Grant, CHE-7421480.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0014, STABILIZED SKIN STUDIES

M. Plummer, Grumman Aerospace Corp., *S. Oyster Bay Rd., Bethpage, New York* 11714 (DF142070; F33615-78-C-3215)

Performance requirements of advanced military aircraft indicate the desirability of using titanium as a major structural material to achieve the necessary strength-to-weight fraction, thermal capability, or both. The high cost of both the material and conventional primary production processes makes acquisition costs for titanium structural hardware non-competitive with more conventional materials. The objective of this effort is to define design options utilizing advanced titanium construction methods which allow more efficient use of material and production innovations. A goal of 25 percent or more acquisition cost-reduction with no sacrifice of structural weight, integrity, or life is required.

A number of stabilized skin panels utilizing superplastic forming and diffusion bonding will be designed to satisfy realistic type design criteria. They will be fabricated and tested. The results will be analyzed, tabulated, and compared with the best existing design technologies presently in production use.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

3.0015, INTERACTIVE EFFECTS BETWEEN TRANSITION METAL IONS IN OXIDE GLASSES

R.K. MacCrone, Rensselaer Polytechnic Inst., School of Engineering, Dept. of Materials Engineering, *110 8th St., Troy, New York* 12181 (DMR77-11322 A01)

Previous work using electric and magnetic susceptibility has estabished that in dilute concentrations (0-10 moles percent), transition metal ions form ordered complexes in oxide glasses. Further investigation into these complexes will be accomplished using the techniques of mixed valence charge transfer optical absorption and electron paramagnetic resonance. The objectives will be to understand how the chemical composition of the host glass and the valence concentration ratio of the contained transition metal ions affect the glass structures.

Mixed valance charge transfer optical absorption will be used as a tool to study the formation of transition metal ion complexes as a function of transition metal ion concentration, transition metal ion type, valence concentration ratio, host glass composition and thermal history. At the same time the physics

of the absorption bands will be studied to investigate the phonon and exchange interaction.

Electron paramagnetic resonance measurements will be used on selected glasses as complementary techniques to study the transition metal ion complex structure through the antiferromagnetic coupling effects of the exchange integral. The temperature dependence of the resonance in selected glasses, subjected to the experimental variables above, will be measured and compared to the behavior expected of specific structural models.

This is a continuation of NSF Grant DMR77-11322.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

3.0016, PREBIOTIC SYNTHESIS - BIOMOLECULES FROM HCN

J.P. Ferris, Rensselaer Polytechnic Inst., School of Science, Dept. of Chemistry, *110 8th, Troy, New York* 12181 (CHE76-11000 A02)

The isolation of orotic acid by the hydrolysis of the HCN oligomers suggests that pyrimidines and pyrimidine derivatives may have been formed from HCN on the primitive earth. The conversion of orotic acid to uracil and orotidine as part of the further investigation of this prebiotic pathway to pyrimidine nucleosides is being investigated. The decarboxylation of orotic acid is being attempted in the presence of anions which may have existed on the primitive earth. The investigation of the synthesis of orotodine starts with a study of the reactions of alkali metal and transition metal salts or orotic acid with a bromoribose derivative. When the factors which control orotidine synthesis are more clearly understood the reaction will be studied using a prebiotic ribose derivative. The investigation of the products formed by the hydrolysis of the HCN oligomers to see if other classes of biomolecules besides purines, pyrimidines and amino acids are formed is being continued. The pathway for the oligomerization is being probed using carbon-14 labelled and N-alkyl derivatives of diaminomaleonitrile. The effect of clay on the oligomerization of HCN and peptide bond formation mediated by HCN oligomers is being investigated. This work is a continuation of that currently supported by Foundation grant, GP-40080X.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0017, CHARACTERIZATION OF STRUCTURE OF A POLYMER WITH A MAGNETIC RESONANCE SPECTROSCOPY

W.M. Ritchey, Case Western Reserve University, Case Inst. of Technology, Dept. of Chemistry, *2040 Adelbert Rd., Cleveland, Ohio* 44106 (NSG 3241)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

3.0018, PLASTIC DEFORMATION BEHAVIOR OF SINGLE-CRYSTAL ALUMINA (NON-BASAL SLIP)

R.E. Tressler, Pennsylvania State University, University Park Campus, School of Liberal Arts, Dept. of Materials Science, *110 Sparks Bldg., University Park, Pennsylvania* 16802 (DMR76-83412 A01)

Research will be continued on the study of the plastic deformation dynamics and dislocation substructures of C- and A-axis sapphire deformed by pyramidal and prismatic slip, respectively. The results of differential strain-rate and differential temperature tests and detailed substructure evaluation as a function of the deformation parameters (strain, strain rate, and temperature) will be used to determine the rate-controlling mechanisms(s) of deformation via these non-basal slip systems in undoped sapphire. The investigation of solute (Cr3 ion, Ti3 ion, Ti4 ion, and Mg2 ion) effects and precipitate effects (Ti4 ion-rich precipitates) on the yielding and flow behavior and the dislocation substructures will be continued. The results of this program will add to the fundamental understanding of the non-basal dislocation behavior in sapphire and elucidate the reason for the insensitivity of the deformation behavior to solutes and precipitates in these non-basal slip modes.

Ultimately, with the fund of published knowledge on basal slip and the information from this program, the plastic flow behavior of sapphire in uniaxial stress states can be mapped out as a function of orientation, strain rate, and temperature.

This is a continuation of research initiated under NSF Grant DMR-74-14118.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

3.0019, RESEARCH ON HIGH DENSITY DIAMANTANE FUELS

A. Schneider, Suntech Inc., *P.O. Box 1135, Marcus Hook, Pennsylvania* 19061 (DF462920; F33615-78-C-2037)

The objective of this program is to develop high energy density liquid and solid hydrocarbon propellants based on the structures of diamantane and triamantane.

This program involves the laboratory syntheses of potential high energy density hydrocarbon propellants based on the structures of diamantane and triamantane. The contractor will measure and report the physical properties of all new compounds, and will supply experimental samples to the government.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

3.0020, SIGMA-PI REARRANGEMENT IN TRANSITION METAL COMPLEXES

M. Tsutsui, Texas A & M University, College Station Campus, School of Science, Dept. of Chemistry, *College Station, Texas* 77843 (A-420)

The results obtained by the studies on 'Sigma-pi Equilibria in Transition Metal Complexes' during recent few years have led us to explore broader and more general fundamental areas of transition metal complexes such as the nature of bonding and 4f and 5f elements. The X-ray diffraction analysis and X-ray photo-electron spectroscopy (ESCA) of organic derivatives of 5f elements (uranium and thorium) have revealed strong evidence of covalency in their bonding.

The two 'shake-up' satellite photopeaks observed in the U(4f) spectra probably arise from electron charge-transfer from molecular orbitals of both metal and ligand character to the corresponding anti-bonding molecular orbitals.

Satellite structures of Ln 3d5/2 photoelectron lines have been investigated for a number of diphthalocyaninatolanthanide (III) and -actinide (IV) complexes. Ligand yields shake-up satellites were not observed in Pr, Nd, and Gd complexes, while La, Ce, Th, and U complexes showed strong shake-up peaks. A new interpretation is put forward to explain the sharp variation in intensity observed throughout the lanthanide and actinide series.

SUPPORTED BY Robert A. Welch Foundation

3.0021, COMBUSTION MODELING OF SOLID PROPELLANTS

M.W. Beckstead, Brigham Young University, School of Engineering Science & Technology, Dept. of Chemical Engineering, *B-166 A S B, Provo, Utah* 84601 (DF054900; AFOSR-79-0100)

AF function - nearly all future Air Force rocket propulsion systems will use solid propellants. Deficiency - current analytical and experimental techniques are inadequate for accurate prediction and assessment of the combustion characteristics of these propellants. Objective - the objective of this research is to advance knowledge in four areas needed to understand the combustion of solid rocket propellants. These areas include diffusion flame analysis, aluminum combustion effects in double base propellants, catalyst effects in composite propellants and distributed combustion effects on propellant response function calculations. How work contributes - the results of this work will provide information needed to improve current analytical and experimental tools for predicting propellant steady and nonsteady combustion behavior and rocket motor performance.

An oxygen-methane diffusion flame burner will be built and used to collect data to assess various assumptions currently em-

ployed in application of the Burke-Schumann flame analysis to solid propellant combustion. A version of the BDP model, modified to account for double base binders, will be extended to treat aluminized propellants by incorporating a model for aluminum agglomeration. The resulting combustion model will be evaluated by examining predicted effects on burn rate, exponent, temperature sensitivity and combustion response. A version of the BDP model, modified to treat the effects of catalysts, will be evaluated against data currently available on catalyst effects on propellant combustion behavior. An aluminum agglomeration model will also be coupled to an acoustic calculation to examine distributed combustion effects on propellant response characteristics by comparing predictions with T-burner data. A steady-state model will also be evaluated in terms of its capability to predict propellant nonsteady response characteristics.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0022, MATERIALS SUPPORT TECHNOLOGY - CHARACTERIZATION OF ORGANIC MATERIALS

C.H. Wang, Utah Higher Education System, University of Utah, School of Science, Dept. of Chemistry, *1400 E. 2nd S., Salt Lake City, Utah* 84112 (DN323116; N00014-75-C-0908)

Organic materials, such as polymeric coatings and lubricants, are in wide Navy use, and in order to predict their reliability under a variety of conditions, it is essential to understand their characteristics, and especially their breakdown mechanisms. It is proposed in this research to study the changes of physical properties of organic materials in the vicinity of transition points, such as glass transition temperatures, and to correlate changes in these materials with their molecular properties.

Low frequency intra- and intermolecular motions of molecules in solids, liquids, and liquid crystals will be studied, using an electric field-induced Raman scattering, Brillouin scattering and other techniques. These studies will be carried out under varying conditions of temperature to observe changes near transition points.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0023, SOME ASPECTS OF FATIGUE CRACK CLOSURE IN ALPHA-BETA TITANIUM ALLOYS

C.J. Beevers, University of Birmingham, *P.O. Box 363, Birmingham, England, United Kingdom* (DF289790; AFOSR-79-0045)

AF function - research in improved, more reliable, lighter and longer lifetime air frame components. Deficiency - present methods of predicting the performance of titanium components are hindered by a lack of understanding of fatigue crack growth. Research - the aim of the proposed research is to understand the mechanics of fatigue crack growth, particularly the effects of fatigue crack closure in an alpha-beta titanium alloy. The work will consist of preparing, testing and analyzing the data from a series of one-inch-thick compact tension specimens tested over the growth rate range 10-4 to 10-2 mm/cycle and at an r ratio of 0.1. The crack extension will be monitored by optical, potential drop and compliance measurements simultaneously.

It is expected to answer the following questions: (1) What are the conditions under which fatigue crack closure occurs and what is the effect of load interaction on crack closure? (2) What is the magnitude of closure effect in terms of applied and effective stress intensity factors? (3) What is the crack growth rate relationship to both applied and effective stress intensity factors?

SUPPORTED BY U.S. Dept. of Defense, Air Force, European Office of Aerospace Research & Development

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, IR MINI-SCANNER MISSION EFFECTIVENESS INVESTIGATION

J.V. Wester, Lockheed California Co., *Burbank, California* 91503 (DN081062; N62269-79-C-0348)

To establish, on a preliminary basis, the mission effectiveness of the infrared mini-scanner concept for air ASW application against current and projected threats. This work supports work unit ZU701, Agency Accession No. DN681083.

Formulate modifications to existing ASW system analysis models to include infrared line scanning sensors. Generate preliminary operational performance data for a limited scope of aircraft type, tactical system configuration and mission scenarios. Generate preliminary concepts for the integration of the mini-scanner into P-3 and S-3 aircraft and estimate the associated recurring and non-recurring costs.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Sensors & Avionics Tech Directorate

4.0002, SEARCH FOR STABLE ONE-DIMENSIONALLY CONFINED PLASMA CONFIGURATIONS

O. Buneman, Stanford University, School of Engineering, Dept. of Electrical Engineering, *Stanford, California* 94305 (ENG78-01559)

The equilibrium properties of planar plasma configurations will be investigated from a theoretical and numerical point of view with the objective of determining those characteristics that result in stable configurations. Interest will focus on 'plywood' models in which current filaments in the plasma flow in different directions as one progresses through successive layers of the structure. Particular attention will be placed on the numerical methods. An effort will be made to reduce the computations needed to analyze particular structures. The analysis will include considerations of the effects of magnetic fields other than those arising from the current distribution and the effects of particles whose motion remains undetermined in the formulation.

This is a continuation of research previously supported under NSF grant ENG-7602402.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0003, RESONANT ABSORPTION AND PARAMETRIC DECAY INSTABILITIES IN LASER-GENERATED PLASMAS

P.W. Chan, Colorado State University, School of Engineering, Dept. of Electrical Engineering, *Fort Collins, Colorado* 80523 (ENG78-05894)

This program is an experimental investigation of anomalous heating of plasmas produced by irradiation of polysterene targets with carbon dioxide laser radiation. Plasma heating due to resonant absorption at oblique incidence and to the parametric decay instability are being investigated in detail. For the study of resonant absorption, the CO2 laser is split into two beams - one is used for plasma production and the other is used for plasma heating at different angles of incidence. The diagnostics include measurements of absorbed CO2 laser energy using an integrating sphere, measurement of electron and ion energy using a retarding potential energy analyzer, and determination of the spectra of resonant oscillation by incoherent scattering using a probing ruby laser beam. For the study of plasma heating via parametric decay instability, a single CO2 laser beam is used for plasma generation and heating. A probing ruby laser beam is used for scattering to observe the spectra of the electron-plasma and ion-acoustic lines. The frequency shifts of these lines can be used for positive identification of parametric decay instability. The line-widths give the damping rate and the line intensities (corresponding to growth rates), which are studied as functions of the incident laser power density. The absorbed laser energy, electron and ion energy are monitored as in the case of resonant absorption. In addition, temporal and spatial resolved holographic interferometry, Schlieren and shadowgram are employed to measure density, density scale length and electron temperature.

This is a continuation of research previously supported under NSF grant ENG-7418623.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0004, TWO-DIMENSIONAL HOLOGRAPHIC SCANNER INVESTIGATION

C.S. Ih, University of Delaware, School of Engineering, Dept. of Electrical Engineering, *Newark, Delaware* 19711 (ENG76-17987)

This research relates to the use of a single rotating multihologram system to provide a required two-dimensional scan automatically, and a simple means to dynamically stabilize the scanning beam. Analysis indicates that very high resolution (10 to the 7th power total resolution elements) could be achieved with scanners of moderate size and operating speed.

The program consists of analytical investigations and experimental demonstrations in the optical (visible) region. The main areas to be investigated include configurations and resolution, dynamic beam stabilization, multiplexing techniques, different wavelength operations, replication techniques, and static and dynamic demonstrations of hologram scanners. The results have application in infrared, millimeter, microwave, and ultrasonic imaging systems.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0005, FUEL DUMPING BY USAF A/C

H.J. Clewell, U.S. Dept. of Defense, Air Force, Engineering & Services Center, Engineering & Services Lab., *Tyndall Air Force Base, Panama City, Florida* 32403 (DF407170)

To assess the extent and environmental impact of fuel dumping by USAF aircraft, and to determine optimal procedures for minimizing any negative impact.

Extent of AF fuel dumping will be assessed by establishment of an AF-wide fuel dump reporting system and tabulation of reports. Physical behavior of the dumped fuel will be determined through wind tunnel modeling, computer simulation, and studies of actual dumps.

SUPPORTED BY U.S. Dept. of Defense, Engineering & Services Center, Engineering & Services Lab.

4.0006, CODING FOR MEMORY-LESS MULTIPLE-ACCESS CHANNELS

S. Lin, University of Hawaii System, Manoa Campus, School of Engineering, Dept. of Electrical Engineering, *Bachman Hall, Honolulu, Hawaii* 96822 (ENG78-05151)

Recent developments in satellite communication systems, computer communication networks and other communication systems involving multiple users require the investigation of the problem of the simultaneous transmission of information amongst several terminals over a common communication channel. Recent research results indicate that multiple users can communicate data with arbitrarily small probability-of-error over a common memory-less channel provided that the rates for the individual data streams lie within the capacity region for the channel.

This research program is concerned with coding for a special multiple user communication channel called the memory-less multiple access communication channel. The objectives of the research are: (1) to construct good (block or trellis) codes for the memory-less multiple access communication channel; and (2) to find practical methods for encoding and decoding these codes.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0007, DESIGN AND ANALYSIS OF PERIODIC SEQUENCES

M.B. Pursley, University of Illinois, Urbana Champaign Campus, School of Engineering, Dept. of Electrical Engineering, *207 Engineering Hall, Urbana, Illinois* 61801 (ENG78-06630)

There are a number of important electronic systems engineering problems which require sets of periodic sequences with good correlation properties. Examples include multiple-access communications, synchronization, ranging, tracking, multiple-terminal system identification, and communication via multipath channels. New techniques for the selection of sets of sequences with pre-specified correlation properties are needed to solve the signal design problems associated with such applications. In addition, new methods for the analysis of sequences and the evaluation of their key correlation parameters are required for system performance analysis. The analysis and design of sequences is the subject of this research investigation.

This action renews the research project presently supported under NSF Grant ENG75-22621.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0008, UNSTEADY TRANSONIC FLOW WITH HEAT ADDITION

M. Sichel, University of Michigan, Ann Arbor Campus, School of Engineering, Dept. of Aerospace Engineering, *Ann Arbor, Michigan* 48104 (ENG76-23982)

Two problems in unsteady transonic flow will be analyzed: 1) to explore the possibility of using similarity series to solve the transonic equations with heating accounting for the existence of shock waves or exothermic discontinuities; 2) to develop a dynamic model of oscillatory condensation for flow where the characteristic reaction or condensation time is much smaller than the characteristic unsteady flow time.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0009, CARRIER TRANSPORT IN HETEROJUNCTION DEVICES

E.S. Yang, Columbia University, School of Engineering & Applied Science, Dept. of Electrical Engineering, *Broadway & W. 116th St., New York, New York* 10027 (ENG78-19426)

Electronic properties of heterojunctions and heterostructure semiconductor devices are being investigated as part of an electronic device program. The special areas of research include (1) carrier transport in p-N and p-P heterojunctions, (2) carrier confinement and leakage, and (3) current-voltage characteristics of double-heterostructure devices. The work centers on device operating conditions dominated by radiative recombination effects and provides calculations and/or experimental observations of current-threshold and current-voltage properties of heterojunction structures. Experimental and theoretical work is being performed with devices fabricated in the Columbia University laboratory and with developmental devices available from industrial research organizations.

SUPPORTED BY U.S. National Science Foundation, Div. of Engineering

4.0010, MAGNETOELASTIC RAYLEIGH WAVES

G.L. Thomas, State University of New York, Stony Brook Campus, School of Engineering & Applied Science, Dept. of Electrical Engineering, *Stony Brook, New York* 11794 (ENG77-12151)

An experimental and theoretical study of magnetoelastic surface waves will be undertaken. The specific areas to be investigated include: (1) propagation characteristics of magnetoelastic Rayleigh waves (MERWs) for varying cuts of yttrium iron garnet (YIG) discs and films and varying propagative and bias field directions for frequencies extending to above one gigahertz; (2) the role played by magnetic domains in observed propagation and excitation properties of MERWs; (3) characteristics of recently observed magneto-acoustic volume-like modes in YIG discs and films; (4) tunability properties of MERW reso-

nators; and (5) design of MERWs on bulk substrates and thin films of strongly magnetostrictive rare earth-iron compounds.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0011, BACK-SCATTER/FORWARD-SCATTER/TERRAIN SCATTER RELATIONS
R.J. Papa, U.S. Dept. of Defense, Air Force, Rome Air Development Center, *Griffiss Air Force Base, Rome, New York* 13441 (DF904630)

AF function - surveillance. Deficiency/opportunity - existing surveillance radar systems have difficulty in estimating the height of low flying aircraft and do not optimize the overall performance capability of the radar. Objective - to predict radar multipath returns over a real earth from a causal relation between back scatter and forward scatter returns and other site-dependent data. Also, to improve existing multipath models for specular and diffuse scattering. How research contributes - improved multipath models will yield more accurate determination of the positions of aircraft and improve a radar system's performance in a more cost-effective fashion. The results of these investigations will be applied to several radar sites along the DEW line (project Seek Frost).

Utilize existing models of scattering from random, rough surfaces and correlate theoretical and computer models with experimental data. Types of terrain and sea states will be delineated for which an accurate theoretical model exists, capable of giving a causal relationship between the forward scattering (multipath) and back scatter (clutter). Theoretical and computer models will be extended to include the effects of terrain screening, shadowing and multiple scattering, and these models will be compared with experimental data taken under contract. The types of terrain to be investigated will be selected from several sites along the DEW line.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0012, SUMMER FACULTY FELLOWSHIP PROGRAM IN ENGINEERING SYSTEMS DESIGN
E.G. Abu Sabu, University of North Carolina, North Carolina Agricultural & Technical State University, School of Engineering, Dept. of Architectural Engineering, *N. Dudley St., Greensboro, North Carolina* 27411 (NGT 34-012-800)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of External Relations

4.0013, DISTRIBUTED DIGITAL CONTROL OF MANIPULATOR SYSTEMS
W.E. Snyder, University of North Carolina, North Carolina State University, School of Engineering, Dept. of Electrical Engineering, *Raleigh, North Carolina* 27607 (ENG77-06771 A01)

This research examines the problem of controlling a coordinated system of mechanical actuators by means of a distributed network of digital processors, one processor for each actuator. In order to realize such a system, two problems, the control theory problem and the networking problem, will be investigated. To have independent, identical processors, control algorithms will be designed that are capable of estimating load parameters in real-time. Second, in order to achieve coordinated motion, techniques will be devised to permit the various controllers to communicate. This is a distributed processing problem seeking to use microprocessors to control a general purpose manipulator.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0014, TURBINE ENGINE COMBUSTION TECHNOLOGY
R.P. Bradley, U.S. Dept. of Defense, Air Force, Aero Propulsion Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF462060)

Quantify the effects of fuel character variation on current combustion systems and examine methods of reducing these effects. Determine the benefits of main burner and after-burner catalytic combustion. Evaluate non-perturbing instrumentation to measure temperature and specie concentration within practical combustion devices.

Conduct combustor rig tests in RM 20 using the F101, catalytic combustor, and combustion tunnel and conduct afterburner tests in C-stand using the J85. Vary fuel properties, test conditions, and hardware configurations while measuring emissions, temperatures, pattern factors and performance parameters using conventional and in-situ techniques.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0015, HIGH SPEED INSTRUMENTATION FOR GENERATOR TEST FACILITY
E.J. Caputo, U.S. Dept. of Defense, Air Force, Aero Propulsion Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF458970)

Complete the AFAPL generator test facility by providing a data acquisition and control system with the following capabilities: (1) sufficient acquisition speed to characterize aircraft electrical system transient performance, (2) storage of all performance-related test data, (3) short time playback and analysis capability, (4) complete automation, and (5) engine-start simulation.

Design system and procure and integrate all necessary components to accomplish objective. System will be composed at a MODCOMP II computer, a high density digital tape drive, 18 10-microsecond conversion A/D converters, and necessary interfacing and control circuitry. The MODCOMP II will be a satellite in the AFAPL computer network.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0016, TURBOMACHINERY FLUID MECHANICS
Wennerstrom, U.S. Dept. of Defense, Air Force, Aero Propulsion Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF458780)

The objective of this task is to contribute to the aerodynamic technology required to design turbomachinery of low aspect ratio and high stage loading. This is fundamental to reducing the manufacturing and maintenance costs and improving the mechanical integrity of aircraft turbine engines.

The approach involves three parallel lines of effort: (a) analytical methods are being upgraded to include three-dimensional and time-unsteady effects, (b) data are being obtained through controlled experiments and advanced instrumentation, better defining three-dimensional and time-unsteady features of the turbomachinery gas path, and (c) design innovations such as splitter vanes, vortex generators for boundary-layer control, etc. are being experimentally evaluated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0017, CATHODOLUMINESCENCE STUDIES OF AMPHOTERIC DOPANTS IN GAAS
Y.S. Park, U.S. Dept. of Defense, Air Force, Avionics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF117470)

The objective of this program is to attain a knowledge of the behavior of amphoteric dopants in epitaxial and semi-insulating GaAs with the goal of obtaining a better understanding of the thermal conversion of semi-insulating GaAs.

The work will utilize cathodoluminescence and Hall measurements as the principal techniques to analyze the characteristics of ion-implanted epitaxial and semi-insulating GaAs substrates. The behavior of amphoteric dopants such as Si or C will be studied by implantation into GaAs in order to elucidate the in- or out-diffusion mechanism and changes in the lattice location of amphoteric impurities. The effect of fabrication parameters on dopant type will be assessed. Samples will be prepared under differing implantation conditions in both semi-insulating GaAs and GaAs epi-layers. Parameters such as dose rate, target temperature, surface-encapsulants, and annealing conditions will be varied in preparation of the samples. Dual implantation will also be performed to determine conditions which produce N- or

P-type activity in GaAs. Comparison of luminescence results with Hall results should provide considerable insight into the effect of implant and annealing conditions on the behavior of amphoteric dopants implanted in GaAs.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0018, TURBULENT FLOW RESEARCH

J.H. Lee, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF143170)

Turbulence is an unsolved problem in fluid mechanics, yet one confronts it in many types of aerodynamic work. For this reason, a long-range research program has been instituted to understand the basic mechanics of turbulence and thereby develop new techniques that can be implemented to effectively solve the engineering type of shear flows such as turbulent jets and boundary-layer flows. A particular emphasis is placed on the aerodynamic/structural interaction problems in which the turbulent fluid motion brings about random excitation to part of the aircraft structure or the entire aircraft, thereby affecting the flight dynamics.

The rigorous treatment of turbulence involves analysis of the Navier-Stokes equations using statistical mechanics, random process techniques, stochastic simulation, and model approaches of constructing dynamic equations which share certain features of the Navier-Stokes equations. Probabilistic techniques are used to deal with the structural response excited by random aerodynamic fields. Important parameters are the statistical mean and variance, and power spectral density of the random variables.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

4.0019, ESTIMATION OF AERODYNAMIC FORCES AND MOMENTS FOR MISSILES

F.M. Sawyer, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF144530)

This work unit supports TF03, Flight Control, and specific goal FG04A2, Flight Control System Design Techniques. The problem area is the accurate determination of aerodynamic stability and control characteristics for missiles during the design phase. The objective is to systematically compare the results obtained from current missile computer programs with wind tunnel data for selected missile configurations. Results of this study will enable assessment of the accuracy of the various existing methods and will provide a basis for selection of the most promising approach for future program development.

Several existing computer programs will be used to predict the aerodynamic characteristics for circular and elliptical cross-section missile configurations. These results will be systematically compared with wind tunnel data to assess numerical accuracy. The computational techniques will also be compared to identify relative strengths and weaknesses.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

4.0020, INTERFACE HARDWARE DESIGN CONSTRUCTION AND MAINTENANCE

R. Trapani, Trapani Engineering Inc., *Berwyn, Pennsylvania* 19312 (DN081318; N62269-79-C-0059)

To design and construct various items of interface hardware for the Basic Configuration No. 1 laboratory effort. To provide maintenance support for various items of interface hardware.

To procure from the original manufacturer of several of GFE interface hardware the services and material necessary to perform above objective.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Communication Navigation Tech Directorate

4.0021, PHOTOREFRACTIVE PROCESSES FOR OPTICAL STORAGE AND DISPLAY

C.M. Kim, Rice University, School of Engineering, Dept. of Electrical Engineering, *6100 Main St., Houston, Texas* 77001 (ENG76-15006)

This program will examine holographic data storage and display in photorefractive materials. The thrust will be two-fold: (1) theoretical and experimental investigation of the physical processes and relevant crystal properties responsible for the photorefractive effect and the limitations imposed by them on desired device parameters, and (2) preparation of crystals with optimal properties and investigation of convenient techniques for the development of optical memory devices with predictable and desired characteristics. The crystals to be investigated include several transition metal-doped ferroelectrics. Characteristics of drift and photogenerated space charge fields in the crystals will be examined using holographic, photoelectronic, and chemical measurement techniques.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0022, SUMMER FACULTY FELLOWSHIP PROGRAM IN ENGINEERING SYSTEMS DESIGN

D.J. Norton, Texas A & M University, College Station Campus, School of Engineering, Dept. of Aerospace Engineering, *P.O. Box F E 44, College Station, Texas* 77843 (NGT 44-001-800)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of External Relations

4.0023, ION AND ELECTRON CYCLOTRON PLASMA WAVE STUDIES

J.E. Scharer, University of Wisconsin, Madison Campus, School of Engineering, Dept. of Electrical Engineering, *Madison, Wisconsin* 53706 (ENG75-19259 A01)

Theoretical and experimental studies of wave effects in magnetoplasmas will be conducted. The program will emphasize wave propagation and heating in the ion cyclotron range of frequencies and nonlinear processes excited by electron cyclotron waves. The objectives of the research are: 1) To obtain a solution to the fast Alfven wave mode conversion problem for multiple ion species plasmas and to assess potential advantages and disadvantages of this process for plasma heating. 2) To determine propagation characteristics and absorption processes for the mode-converted slow wave. 3) To examine the fast wave heating problem for larger Tokamaks where many eigenmodes exist within the absorption Q for a single eigenmode. 4) To conduct experiments to observe and model mode conversion and nonlinear electron cyclotron wave processes in a two-ion plasma.

This is a continuation of research previously supported under NSF grant ENG-7519259.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, SEASAT PROGRAM - USE OF SEASAT DATA TO INVESTIGATE CONNECTIONS BETWEEN SEA-SURFACE TEMPERATURES AND METEOROLOGICAL FACTORS

S.A. Bowling, University of Alaska, Fairbanks Campus, Geophysical Inst., *Fairbanks, Alaska* 99701 (7-925; MO-A01-78-00-4321)

OBJECTIVE: The use of SEASAT-A SMMR sea-surface temperature and wind speed data to examine the immediate effect of meteorological events, especially cyclone passages on sea-surface temperatures in the Gulf of Alaska/Aleutian area.

APPROACH: The SMMR data will be processed by differencing of temperatures obtained at different times to obtain

maps of cooling/heating rates, which will then be compared both with SMMR-derived wind speeds and with conventional meteorological data. Conventional meteorologial data will be used to select three periods during winter 1978-79, during fall, mid-winter and early spring. SMMR geophysical data tapes will be obtained during these periods, as well as IR imagery, if available. Major emphasis will be on patterns of temperature change relative to the positions of major meteorological features, and identification of those which are consistent enough to have a high probability of being real.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Environmental Satellite Service

5.0002, CARBON-14 FLUCTUATIONS IN THE ENVIRONMENT OF EARTH AND ATMOSPHERE
P.E. Damon, University of Arizona, School of Earth Sciences, Dept. of Geochemistry, *Tucson, Arizona* 85721 (EAR78-21813)

This is a continuation of NSF grant EAR74-13362 to continue investigations of 14C fluctuations and their causes. Long-term fluctuations in 14C production will be examined by analysis of the oldest bristlecone wood and other suitable material. Short-term 14C fluctuations of dated material from the Medieval Warm Epoch (AD 1150 to AD 1250) will be investigated to determine 14C atmospheric variations related to climate change. Previous analyses of bristlecone material that were significantly discordant with respect to adjacent material will be repeated. A model of the relationship between geomagnetic excursions, reversals plus other changes in the Earth's dipole moment, and 14C variations will be constructed. This will be used to calculate the effect of industrial additions of CO2 to the atmosphere. In addition, the work will evaluate relationships between 14C, climate and solar constant by study of the bristlecone data.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Earth Sciences

5.0003, MEASUREMENTS OF CONTINUOUS ABSORPTION BY ATMOSPHERIC TRANSMISSION CODES
D.E. Burch, Ford Aerospace & Communications Corp., *Ford Rd., Newport Beach, California* 92663 (DF582430; F19628-79-C-0041)

AF function - surveillance satellite, meteorological satellite. Deficiency - lack of knowledge of infrared absorption properties of the atmosphere. Objective - conduct laboratory measurements of water vapor and other atmospheric gases in the 20-30 micrometers, 2.7 micrometers, 6.3 micrometers and in the 3-5 micrometers and 10 micrometers window regions. How research contributes - atmospheric molecular absorption primarily by water vapor is being studied in order to provide fundamental spectroscopic data for inclusion in atmospheric transmission codes.

Laboratory measurements of absorption by various atmospheric gases with emphasis on the continuum or line wing component will be made in order to provide direct input data in the AFGL standard atmospheric transmission codes. Emphasis will be placed on the measurements and analysis in the spectral regions containing significant contributions from line wings or continuum absorption.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0004, DESIGN FABRICATION AND ENGINEERING SUPPORT OF ATTITUDE-CONTROL SYSTEMS
S.D. Lyon, Space Vector Corp., *Northridge, California* (DF248830; F19628-77-C-0251)

AF function - direct support of SAMSO infrared measurements program. Deficiency - lack of knowledge of rocket attitude-control and behavior. Objective - to provide the Air Force with a reliable, accurate, and low-cost attitude-control system (ACS) for ARIES sounding rockets. How research contributes - provides rocket-borne payloads with sufficiently accurate attitude-control for probing the infrared aerospace environment.

Develop and fabricate a state-of-the-art, highly accurate attitude-control system for the ARIES rocket.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0005, DEVELOPMENT OF INSTRUMENTATION FOR MONITORING CARBON FIBER EMISSIONS
S. Pollack, Thompson Ramo Wooldridge Inc., Defense & Space Systems Group, *1 Space Park, Redondo Beach, California* 90278 (68-02-3273; G712B-BE-021)

OBJECTIVE: The objective of the work is to develop prototype instrumentation for monitoring carbon fiber emissions.

APPROACH: Existing carbon fiber measuring equipment will be evaluated for application to continuous monitoring of carbon fiber emissions. Equipment(s) and modifications will be recommended for the monitor, and a prototype system will be fabricated and evaluated.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Sciences Research Lab.

5.0006, SIERRA CLOUD LIQUID
J. Snider, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (RAA7 72 47)

PROJECT OBJECTIVE: To participate in sponsor's winter 1979-80 cloud seeding program. To obtain data to help assess ability of microwave radiometry to measure liquid water content in clouds.

CURRENT YEAR PLAN: Operate 28 GHz satellite receiver-radiometer during the December-February 1979-80 Sierra Cooperative Pilot Program at a location near Auburn, CA, to measure cloud liquid water content. Compare liquid measured by receiver-radiometer with data taken by probe-carrying aircraft.

SUPPORTED BY U.S. Dept. of the Interior, Water & Power Resources Service

5.0007, SEISMIC OBSERVATORIES
H. Whitcomb, U.S. Dept. of the Interior, Geological Survey, Branch of Global Seismology, *Box 25046, Denver Federal Center, Denver, Colorado* 80225 (9920-01193)

STATES/COUNTRIES TO WHICH PROJECT PERTAINS: Washington, Guam, Puerto Rico, Alaska.

The GS operates and maintains a national and world-wide network of observing and reporting systems. Included are facilities and systems for describing, mapping and charting the earth, utilizing seismological and geomagnetic science and technology, and conducting related research and development. Observatories supported by this project are located at Newport, Washington; Cayey, Puerto Rico; Agana, Guam; and Adak, Alaska. These observatories provide seismological data which are used to describe the occurrence of earthquakes and their effects on lives and property, and to monitor and record vibrations in the earth caused by earthquakes and large man-made disturbances. Also, observatories at Guam and Newport, Washington provide input on a 24-hour standby basis to the Tsunami Warning Service operated by NOAA in Honolulu. The data produced contribute to a better understanding of the earth's crust, mantle, and core, and of the nature of seismic hazards and risk. Magnetic data are used to update periodically regional and world magnetic charts, and to determine correction factors applicable to magnetic field measurements made by land, marine, and airborne magnetic survey parties. Additionally, this information supports studies in ionospheric physics, radio propagation phenomena, electrical conductivity, the composition of the core and mantle of the earth, and interplanetary space. Knowledge of magnetic declination and its secular change is required as input to the compilation of all sea and air navigation charts for use by marine and aircraft navigators and by public and private surveyors.

SUPPORTED BY U.S. Dept. of the Interior, Geological Survey, Geologic Div.

5.0008, ION MICROPROBE ANALYSES OF FELDSPARS AND UPPER-MANTLE MINERALS
J.V. Smith, University of Chicago, School of Physical Sciences, Dept. of Geophysical Sciences, *5734 S. Ellis Ave., c/o Hinds Geophysics Lab., Chicago, Illinois* 60637 (EAR77-27100)

This project concerns the continued development of ion microprobe trace element analyses and the application of these techniques to the analysis of peridotite nodules from kimberlites, kimberlite groundmass, and the analysis of lithium, beryllium and boron in feldspars.

The peridotites to be studied are the MARID (mica-amphibole-rutile-ilmenite-diopside) suites which have already been characterized in detail petrographically and analytically by electron microprobe for major elements and certain trace elements. This part of the study is of particular interest to the development of models for mag generation in the upper mantle.

Light element analysis will be performed on feldspars from a wide range of environments (authigenic, pegmatitic, granitic, and anorthositic) to determine elemental fractionation under varying conditions. Li, Be, and B are of particular interest because they cannot be determined by electron microprobe methods.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Earth Sciences

5.0009, REMOTE SENSING FOR SOIL SURVEY AND EROSION STUDIES
M.F. Baumgardner, Purdue University, Agricultural Experiment Station, Dept. of Agronomy, *Executive Bldg., West Lafayette, Indiana* 47907 (0008923; IND050020)

OBJECTIVE: Determine quantitatively the relationships between soil radiance and the physico-chemical properties of soils; delineate and map soil differences by digital analysis of multispectral data from air and spacecraft scanners; use digital analysis of multispectral data to prepare soil erosion maps.

APPROACH: The relationships between the radiance (-.48-2.40Mum) characteristics and numerous physical/chemical properties of a broad range of soils will be studied. Computer-implemented pattern recognition techniques, supplemented with field observations, will be used to analyze multispectral data from air and spacecraft scanners to delineate soil boundaries and map meaningful soil differences, including severity of erosion.

PROGRESS: The major long range goal of this research is the development of an advanced global information system for agriculture which integrates the new technologies of data acquisition, data analysis, and communications, or information dissemination. During the project period exploration of the information requirements of a global information system has continued. Specific research has been concentrated on defining quantitatively the relationships between soil reflectance and other physical/chemical properties of soils. This SCS-LARS cooperative research includes the study of duplicate samples of 250 major soil series selected to provide adequate statistical sampling from seventeen climatic regions of the U.S. Results of this study will make a significant contribution to the body of knowledge related to the contributions which different soil constituents make to soil spectral characteristics. With SCS participation, digital analysis of LANDSAT data has provided the principal data base for a detailed soil survey of Jasper County, Indiana. A false color image at a scale of 1:125,000 was used as a base map on which to delineate parent material boundaries. With these digitized boundaries overlaid onto LANDSAT spectral data, a soil map was produced spectrally at a scale of 1:15,840. A detailed description of each map unit has been prepared for publication with the spectral maps. This constitutes the first county to be mapped in detail using digital analysis of LANDSAT data.

SUPPORTED BY U.S. Dept. of Agriculture, Cooperative Research Office, Indiana

5.0010, OCEANOGRAPHIC INSTRUMENTATION - TESTING
E.M. Russin, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Ocean Survey, Office of Marine Technology, *Rockville, Maryland* 20852

TECHNICAL OBJECTIVE: To improve marine measurements made by NOAA and all sectors of the oceanographic community (private, academic, government) through a continuing research and development program of testing and evaluation of marine instrumentation. The program results are available through NOAA to the entire marine community.

APPROACH: Test and evaluate instruments used for the collection of physical, chemical, and biological data used for research and survey of the deep ocean, coastal waters, and estuaries. Maintain a laboratory to simulate the ocean environment. Analyze instrument failure modes for reliability assessment. Encourage the development of new sensors and testing techniques/methods unique to marine instruments and provide analysis of the quality for instrumental measurements. Disseminate results in comprehensive technical reports.

CURRENT PLANS: The FY '79 program includes providing lab/field performance and data quality information on marine instrumentation to measure water level, current speed and direction, conductivity, temperature, wave height and direction, water bottom depth, dissolved oxygen and nutrient-concentration to support NOS' involvement in the Tides and Tidal Currents Program, DOE's Strategic Petroleum Reserve Program, Wave Monitoring Project, Hydrographic Survey Systems, Ocean Dumping Program, and EPA's Pass-Thru Program. T&EL support is also planned for NOAA/NASA's Laser Hydrography experiments and OCEANAV/NORDA's T&E Program.

SUPPORTED BY U.S. Dept. of Commerce, National Ocean Survey, Office of Marine Technology

5.0011, ENERGETIC PROTON DELAY FROM SOLAR RADIO BURSTS
P.M. Bakshi, Boston College, Chestnut Hill Campus, School of Arts & Sciences, Dept. of Physics, *140 Commonwealth, Chestnut Hill, Massachusetts* 02167 (DF583490; F19628-79-C-0084)

AF function - communication and surveillance. Deficiency -capability of accurately predicting time of arrival of solar flare emitted particles does not exist. Objective - to investigate the delay of solar flare energetic particles by means of associated solar radio burst observations. How research contributes - will provide a knowledge of the delay characteristics of energetic solar flare particles to establish prediction techniques for the incidence of solar-related disruptive influences on HF communications, OTH radars, and satellite communication systems.

The correlation between solar radio bursts and the propagation of energetic particles from the sun to the earth will be studied by consideration of such parameters as the burst peak radio flux spectral width (W3/W2), the time development of the radio burst spectral shape, the flare/burst position on the sun, the flare/burst flash phase rise time, and the particle pitch angle distribution.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0012, INTERFEROGRAM DATA ACQUISITION SYSTEM FOR BALLOON-BORNE CRYOGENIC INTERFEROMETER
J.L. Pritchard, Idealab Inc., *Union St., Franklin, Massachusetts* 02038 (DF248480; F19628-77-C-0039)

AF function - surveillance, advanced infrared detection system. Deficiency - lack of high-resolution data of stratospheric emittance in infrared. Objective - to acquire and handle interferogram signal from cryogenically operated interferometer in balloon-borne environment. How research contributes - an instrument sensitive enough to measure stratospheric emission will be made ready for a balloon-borne operation.

A system for acquiring and handling an interferogram signal from a cryogenically operated high-resolution IR interferometer will be designed and fabricated. Tests for interfacing will be conducted to see whether the full sensitivity of the instrument will be achieved to insure a detection of the stratospheric emission for a proposed balloon-borne experiment.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0013, SCATHA INSTRUMENTS

B.F. Sellers, Panametrics Inc., *221 Crescent St., Waltham, Massachusetts* 02154 (DF242880; F19628-74-C-0217)

AF function - communications and reconnaissance. Deficiency -unknown cause of erratic system performance. Research - develop instrument to measure electron and proton fluxes in .05-300 keV energy range. How research contributes - this instrument will be used in the SCATHA satellite as one of a number of sensors intended to define the particle and field environment at synchronous orbit and its effect on satellite performance. It involves the design and testing of feasibility models and the fabrication of flight instruments and associated GSE. Instrument will feature maximization of information and minimization of weight, power requirements and telemetry demands.

The rapid-scan instruments designed for the SCATHA satellite must be shielded against energetic electrons. Appropriate electronic components are to be shielded as well as experimental testing of the detector response to background.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0014, RAPID SCAN PARTICLE DETECTOR DATA INTERPRETATION

B.F. Sellers, Panametrics Inc., *221 Crescent St., Waltham, Massachusetts* 02154 (DF582720; F19628-79-C-0099)

AF function - communication, navigation and command. Deficiency -the data base of the high energy plasma present at synchronous orbit is inadequate to accurately describe observed charging events or to properly relate them to their ultimate cause. Objective - to operate the rapid scan spectrometer at synchronous altitudes and interpret the data returned. How research contributes - data from the rapid scan spectrometer once analyzed and interpreted will provide increased understanding of the geosynchronous plasma environment and its role in spacecraft charging.

The rapid scan particle spectrometer will be operated at the geosynchronous orbit in conjunction with the other instruments on board the SCATHA satellite. The returned data will be analyzed and interpreted to provide definitive answers as to the plasma environment at the geosynchronous orbit as a function of geomagnetic activity, the effect of the plasma on spacecraft charging, and the response of the plasma to beam operations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0015, SATELLITE DATA PROCESSING AND ANALYSIS

R.W. Fioretti, R D P Inc., *Waltham, Massachusetts* 02154 (DF247630; F19628-76-C-0244)

AF function - airborne surveillance, target acquisition. Deficiency - atmospheric density variations with time and space cannot be accurately predicted. Research - direct density measurements with satellite-borne accelerometers. Results are correlated with solar-geophysical parameters and other experiments. How research contributes -permits accurate determination of Air Force satellite ephemerides.

A SETA accelerometer is to be flown on Air Force satellites. This instrument permits high accuracy, high resolution atmospheric density measurements. Telemetry data from all the experiments will be provided on tape. The raw SETA data will consist mainly of drag accelerations which are proportional to density and accelerations due to vehicle motions caused by thrusting. Digital filtering methods are used to determine those accelerations due to drag. Density is calculated directly from the drag data. These results are used to accurately determine the orbit of the satellite. In addition, the density results are used to develop accurate atmospheric models.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0016, DEVELOP INSTRUMENTATION AND TECHNIQUES FOR STRATOSPHERIC ION COMPOSITION MEASUREMENTS

A.D. Bailey, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF581130)

AF function - military operations of supersonic aircraft and other vehicles in the stratosphere. Deficiency - the environmental effects of AF stratospheric operations cannot be accurately predicted for lack of knowledge of normal species concentrations and their spatial and temporal variations. Further, the mixing properties and chemical interactions of jet engines or missile effluents are only poorly defined. Objective - develop and flight-test a viable balloon-borne mass spectrometer system and techniques to determine the ionic composition and electrochemistry of the stratosphere, and conduct an initial measurements effect. How research contributes - ions may be effective sinks for pollutants by serving as condensation nuclei which could aglomerate stratospheric pollutants, forming aerosols which subsequently fall from the stratosphere into the troposphere to be washed out. Payoff could lessen restrictions on Air Force operations.

A cryo-pumped ion mass spectrometer will be designed and developed for balloon-borne measurements of positive and negative ions under both ambient and artificially excited conditions. Extensive laboratory evaluation testing will be conducted, including laboratory experiments with cluster ions to identify charge transfer reactions that alter the ion composition of the stratosphere. A theoretical study of ambient ion masses will be made to guide programming of the ion mass spectrometer measurements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0017, LIDAR MEASUREMENTS OF ATMOSPHERIC DENSITY

D.E. Bedo, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF582840)

AF function - vehicle tracking, RV trajectory prediction, interception. Deficiency - insufficient information on a timely basis of the atmospheric density and variations in density at altitudes below 30 kilometers as is required for advanced reentry systems. Objective - the design, development and fabrication of a satellite-borne laser radar (LIDAR) system capable of providing near real-time remote density measurements at stratospheric altitudes and below. How research contributes - the satellite LIDAR system will probe the lower atmosphere and provide near real-time measurements of the atmospheric density at altitudes below 30 kilometers. Such data are of value to the Air Weather Service in support of strategic missile systems and in the development of low altitude density and weather prediction techniques.

The LIDAR system to be developed will be based on the detection of Rayleigh scattered laser light using a satellite-based transmitter and receiver. The hardened laser will be operated in a pulsed mode with power and repetition frequency determined by mission requirements and specific spacecraft capabilities. The LIDAR design will be compatible with an altitude resolution of one kilometer and absolute accuracy of better than 15 percent in the determination of density. Gating and timing circuitry will restrict the observations to altitudes below 30 kilometers. In addition to density determinations, the scattered signal will provide information on aerosol distributions within the probed regions and will allow deduction of the atmospheric transmission from the satellite to the ground.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0018, SHAPE AND STRESS ANALYSIS OF NATURAL SHAPE BALLOONS

J.F. Dwyer, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF582770)

AF function - advanced balloon system (surveillance, delivery, operations, environmental research support and space equipment test). Deficiency - procedures, adequate for the design of natural shape balloons and the analysis of critical off-

design load/altitude conditions, do not exist. Objective - a general computer code for the generation of natural shape balloon designs and the analysis of such balloons under representative flight conditions will be written and demonstrated for selected practical problems. How research contributes -this computer code will enable rapid evaluation of balloon requirements for proposed efforts including the advantages and disadvantages of system options. Further it will provide a means to evaluate proposed balloon design criteria changes.

A computer code written for the design of natural shape balloons, and using the Runge-Kutta numerical technique, will be modified to provide natural shape balloon designs based upon payload altitude and duration requirements. Rigging weight, recovery parachute weight, and ballast weight modelling codes will be included. The partially inflated ascent deployment configuration of natural shape balloon envelopes will be modelled using the Runge-Kutta or a finite difference method and the entire program tested on existing design shapes and a representative number of selected cases related to known operational problems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0019, INSTRUMENTATION FOR DEKAMETRIC SOLAR-BURST-DISK LOCATION

D.N. Gaunt, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF580850)

AF function - communications and surveillance. Deficiency - at present, burst disk location, an essential element of geophysical prediction, is obtained solely from optical observations, which are sometimes obscured by weather. Objective - to develop the techniques and instrumentation for determining burst disk position from interferometric observations. How research contributes - determination of burst disk position and motion will be helpful in understanding the phenomena and in predicting the travel path of solar energetic particles toward the earth.

Produce a data processing system which will generate a continuous, real-time (seconds) measurement of the position of a radioactive area from data presently available from an existing sweep frequency interferometer. The technique used will measure the displacement of the phase difference of signals (received from the two antennas of the interferometer) from that of a theoretical signal from the center of the sun and convert this to angular displacement which will determine position.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0020, RAPID SCAN PARTICLE SPECTROMETER DATA ANALYSIS

D.A. Hardy, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF583220)

AF function - AF satellite systems operate at synchronous altitudes where charging can occur due to natural causes and may give rise to effects deleterious to the systems. Deficiency - the data base of the high energy plasma present at synchronous orbit is inadequate to accurately describe observed charging events or to properly relate them to their ultimate cause. Objective - to analyze and interpret data from the rapid scan particle spectrometer in conjunction with data from other experiments on the SCATHA satellite. How research contributes - data from the rapid scan particle spectrometer will provide specification of the geosynchronous plasma environment and its relationship to spacecraft charging.

The data from the rapid scan particle spectrometer will be analyzed to provide specification of the electron and ion characteristics at the orbit of the SCATHA satellite, to determine the relationship between the plasma characteristic and the degree of satellite charging, to provide input for the verification of spacecraft charging codes and to aid in the determination of active control methods for spacecraft charging.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0021, AUTOMATED AVIATION WEATHER PREDICTION

B.A. Kunkel, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF582990)

AF function - launch and recovery of military aircraft. Deficiency - lack of timely, automated methods of short range prediction of aviation-critical weather parameters. Objective - to investigate the characteristics of aviation-critical weather parameters such as slant range visibility, low-level wind shear and cloud base height, and to develop and evaluate statistically-based objective techniques which predict their behavior over periods ranging from 0 to 3 hours. How development contributes - the launch and recovery of military aircraft will be less hazardous and more effective, given improved predictions of aviation-critical weather parameters.

Weather data being gathered at the Otis AFB weather test facility (WTF) will be subjected to an extended analysis to determine the temporal and spatial characteristics of slant range visibility, as defined by a multiple sensor array of forward scatter meters (FSM) and transmissometers in a simulated landing zone and from remote towers. Using multivariate statistical methods, such as regression estimation of event probabilities, short range prediction experiments, initially carried out under task 667010, will be extended to consider the additive contribution of multiple FSM and transmissometer measurements. Consider the additive contribution of multiple FSM and transmissometer measurements. Cloud-base height observations will be gathered for a period of one year from an array of three automated rotating beam ceilometers (RBCs) located at the WTF and near an active runway at Otis AFB. An assessment of the representativeness of closely-spaced RBCs observations to automatically specify the required cloud parameters of total sky cover, cloud layer amounts and ceiling will be made. The development and testing of techniques of forecasting baseline cloud base height (or ceiling if appropriate) will be accomplished.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0022, TOP-SIDE IONOSPHERE MEASUREMENTS OF LOW ENERGY

R.C. Sagalyn, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF580770)

AF function - surveillance, communications, navigation and ionospheric modelling. Objective - develop instrument for monitoring ion and electron densities, temperature and scale height in the top-side ionosphere to be used as inputs for ionospheric models. How research contributes - permits improved space communications, frequency management and surveillance at HF and UHF frequencies.

The satellite experiments will be designed, fabricated, tested and integrated in the DMSP satellite. Software programs will be developed to operate on GWC UNIVAC for rapid transmittal to AWS Ionosphere Predictions Program.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0023, EVALUATION OF DMSP WATER VAPOR RADIANCES

F.R. Valovcin, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF583100)

AF function - weather observing, analysis and forecasting for military operations. Deficiency - inability to determine meteorological variables over inaccessible or unfriendly territory. Objective - to recommend operational techniques to derive moisture parameters from DMSP radiance measurements. How research contributes - water vapor obtained from satellite radiance measurements as input into AFGWC's Objective Analysis Program, cloud model, 3DNEPH and numerical forecasting model should provide an improvement in the analysis and forecasting of meteorological variables for AF tactical and strategic operations, weapons and surveillance systems.

DMSP water vapor radiances (emissions) will be correlated with ground truth measurements from polar to equatorial re-

gions and for different seasons. In addition, comparisons of calculations with observed water vapor radiances will be made. Progress - new in-house work unit.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0024, UV ELECTRON AND PROTON FLUX MEASUREMENTS IN THE AURORAL E LAYER

R.A. Van Tassel, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF584090)

AF function - trans-ionospheric ranging and communications, remote ionospheric monitoring. Deficiency - present state-of-the-art in relating natural optical emission to the electron density profile is not understood well enough to permit remote satellite monitoring of the auroral oval. Objective - in situ measurements with rockets of UV, electron and proton fluxes. How research contributes - provides direct measurements of atmospheric parameters to correlate with other measurements and computer codes being generated in the auroral E program.

The approach is to use sounding rockets to measure the following parameters in the auroral E layer - 1) electron flux and differential energy distributions from 1 eV to 20 keV, 2) proton flux and differential energy distributions from 5 keV to 60 keV, and 3) volume emission rates and total column emission rates from atomic oxygen at 5577 angstroms, 2972 angstroms and 1356 angstroms, from neutral nitrogen in the LBH bands and 2nd positive bands, from ionized nitrogen at 3914 angstroms, from hydrogen beta at 4861 angstroms, and from the nitrogen dioxide continuum around 5070 angstroms. All of the measurements will be made from a single rocket payload in the altitude range between 90 and 180 km.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0025, ALTITUDE PROFILE OF NEUTRAL THERMOSPHERIC COMPOSITION AND DYNAMICS

W.K. Vickery, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF248950)

AF function - operate missiles and satellites in and through the upper atmosphere. Opportunity - the DMSP supplementary sensor density package (SSD) requires calibration in order to assure accurate global measurements of atmospheric density. Objective - measure the density profile of major neutral atmospheric species with near-simultaneous measurements of the dynamical structure of the region between 90 and 180 kilometers. How research contributes - provides profile of major neutral species, turbopause altitude and thermospheric temperature profile needed as inputs for the calibration of the DMSP(SSD) package.

Each set of measurements involves two rocket payloads. One payload contains a specially designed neutral mass spectrometer to measure the density of each of the major atmospheric species. The other will dispense a vapor trail for dynamics measurements (including eddy diffusion coefficients, molecular diffusion and turbopause altitude data and temperature measurements). These measurements are combined with measurements of solar UV absorption, electron energy distribution and airglow radiation for a set of essential inputs to support the SSD calibration. The data are collected from the mass spectrometer by telemetry and reduced in terms of the neutral species distribution. Atmospheric dynamics parameters are determined from analysis of time-lapse photographs of vapor trails yielding wind, wind shear and temperature profiles, diffusion coefficients, and indirectly, total neutral density. Two sets of measurements are planned, one in FY79, a second in FY80.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0026, SIGNAL STATISTICS OF INTENSE SCINTILLATIONS

H.E. Whitney, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF580930)

AF function - satellite communications. Deficiency - inadequate knowledge of the effects of ionospheric scintillations on trans-ionospheric radio propagation. Objective - study the signal characteristics of intense scintillation and relate the effects of the propagation path to the performance of satellite communication systems. How research contributes - with a better knowledge of the degradation that can be expected on the communications path from scintillations, mitigating techniques can be implemented to improve the reliability of satellite communications.

The data recorded in Peru during October 1976 and March 1977 on intense scintillations will be computer-processed to provide the required signal statistics. Additional testing will be done in March 1978 to expand the data base on equatorial scintillations. Data from three closely spaced receiving sites will be used to determine the spatial correlation and the feasibility of space diversity for AFSATCOM. Power spectra from ground station data will be compared to aircraft data to determine the effects of the planes' velocity on the scintillation rate. The basic analysis for signal statistics was developed under in-house work unit 46430103 and the work unit is an extension of that effort.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0027, SATELLITE INSTRUMENTATION FOR HIGH ENERGY PARTICLES

G.K. Yates, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF580070)

AF function - navigation, communication and surveillance. Deficiency - inaccurate environmental specification for hardness of microelectronic components will result in insufficient criteria for military satellite systems. Objective - to design, test and calibrate high energy particle and magnetic flux detectors for satellite observations. How research contributes - direct measurement of the energetic particle environment in space will lead to a useful model resolving uncertainties in calculations of radiation hardening requirements.

Designs of state-of-the-art instruments for measuring high energy particles and magnetic flux will be completed. Fabricated instruments acquired under contractual work units supporting this task will be tested and calibrated in preparation for satellite integration.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0028, AEROSPACE PAYLOAD R & D

J.M. Otis, Wentworth Inst. of Technology, Undergraduate School, *550 Huntington Ave., Boston, Massachusetts* 02115 (DF583330; F19628-79-C-0103)

AF function - reconnaissance, surveillance, communication and advanced weapon systems. Deficiency or opportunity - inability to forecast atmospheric interactions affecting the design and operation of military systems such as re-entry vehicles, over-the-horizon radar and satellite operations. Objectives - (a) to perform research and engineering as required in the design, fabrication and test of aerospace payloads and sensors. (b) to redesign, fabricate, test and evaluate component assemblies of existing aerospace vehicles for the purpose of improving reliability and/or cost-effectiveness. How research contributes - the complexities of upper atmosphere and near-space in situ measurements demand state-of-the-art expertise if meaningful data are retrieved. Improved construction techniques and designs can only enhance reliability of experiments directly related to AFGL projects 2310, 6687, 6690, 7659, 7670, and SAMSO program 2123.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0029, ECOLOGICAL STUDIES AND MATHEMATICAL MODELING FOR THE CONTROL OF CLADOPHORA IN THE GREAT LAKES

R.P. Canale, University of Michigan, Ann Arbor Campus, School of Engineering, Dept. of Civil Engineering, *Ann Arbor, Michigan* 48104 (R806600; N769 -0049)

OBJECTIVE: Control the Cladophora problem in Lake Huron along the United States shoreline.

APPROACH: Determine effectiveness of alternate control strategies using mathematical models. Develop models using field and lab experiments. Obtain verification data under varying environmental conditions.

PROGRESS: Project is still in initiation phase. Field station established at Harbor Beach. Coordination achieved with NASA for over-flights.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Research Lab.

5.0030, ANTARCTIC SEA ICE

S.F. Ackley, U.S. Dept. of Defense, Army, Corps of Engineers, Cold Regions Research & Engineering Lab., *P.O. Box 282, Hanover, New Hampshire* 03755 (DPP77-24528)

The proposed work is a three-year project to describe sea ice conditions in Antarctica and their relationship to oceanic and atmospheric processes. Sea ice studies are incomplete without an accounting for their mechanics, thermodynamics, and structural and material properties, which form the bases of the proposed study. The Weddell Sea area has been chosen because of its unique role as a sea ice source and the impact of sea ice problems on other disciplines in this region, including meteorology, physical oceanography and biology.

The four objectives of this project are: (1) To obtain a drift-strain record from drifting buoys. These buoys will also provide meteorological information during the First GARP Global Experiment (FGGE). (2) To use the drift-strain record as a data source for the ice thickness distribution, and as a verification of energy flux estimates from satellite imagery. (3) To provide structural and material property information through a ship and helicopter-based ice drilling, coring, and remote sensing program. (4) To numerically model the sea ice circulation based on the results of the drifting buoy and ice structural experiments.

First-year activities will concentrate on preparations for deploying the buoy array during the 1978-79 field season.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Polar Programs

5.0031, MEASUREMENT OF PHYSICAL AND INSTITUTIONAL FACTORS FOR MANAGING ENVIRONMENTS ON RURAL LANDS

R.S. Freeburg, New Mexico State University, Las Cruces Campus, Agricultural Experiment Station, Dept. of Agricultural Engineering, *University Park, Las Cruces, New Mexico* 88003 (0072329; NM00609)

OBJECTIVE: Measure rates at which watershed characteristics change with development rates during the course of development of rural lands for recreation. Measure changes in water quality resulting from watershed characteristic changes. Assess patterns of development, considering institutional restraints, as to the expected effects on watershed characteristics.

APPROACH: Aerial photographs, in conjunction with information from the county assessor, city and county zoning, and county clerk offices, will be used to determine change in amount and distribution of impervious surfaces within several types of recreational developments. From among developments studied, at least one of each type will be studied in more detail, measuring runoff in major watercourses within developed area, Coliform counts in perennial streams and/or wells where these exist, sediment concentrations in perennial and ephemeral streams which are being influenced by construction activity, water table levels in those areas where water table is near the surface, precipitation. Several construction designs will be computer-simulated for the developments studied and tested, considering institutional restraints, to predict a range of effects to be expected from each development. It will also take into account physical restraints such as topography of land, soil, access, vegetation, etc.

PROGRESS: Monitoring of research sites is continuing. Measurements being made include: 1) inflow to developing sites, 2) outflow from developing sites, 3) rate of build-out on sites, 4) precipitation on sites. Preliminary evaluations of flood-routing patterns are being made to determine changes caused by land development. Results to date reveal rapid amelioration of runoff production in the developed areas in which road building and utility installation have been completed. Build-out rates have diminished in most developments. Land-use history of the development sites has been reviewed. Some of the environmental change due to development have been predicted on the basis of the site histories.

SUPPORTED BY New Mexico State Government

5.0032, MULTI-EXPERIMENTAL STUDIES OF THE WIND AND WAVE PATTERNS IN THE UPPER ATMOSPHERE AND IONOSPHERE

M.C. Kelley, Cornell University, Ithaca Campus, School of Engineering, Dept. of Electrical Engineering, *242 Carpenter Hall, Ithaca, New York* 14853 (ATM77-04518 A01)

This award provides continued funding for research under NSF grant ATM77-04518 and extends the duration by one year. The scientific objectives remain the same, with a modest shift in emphasis to take advantage of the Millstone Hill facility recently upgraded with NSF funds.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

5.0033, GAS CORRELATION FOR CARBON MONOXIDE

L.W. Chaney, U.S. Environmental Protection Agency, *Research Triangle Park, North Carolina* 27709 (DF336440)

To evaluate the capability of gas correlation spectroscopy for the remote (non-contact) sensing of carbon monoxide. Presently available point monitoring sensors have proven unreliable or inappropriate for determining the contribution of airfield operations to local environmental quality. A remote system would provide an integrated pollutant load.

Joint funding with EPA. Two existing systems will be evaluated by an independent party to determine their sensitivity, specificity, accuracy and reliability, and to recommend improvements.

SUPPORTED BY U.S. Dept. of Defense, Engineering & Services Center, Engineering & Services Lab.

5.0034, ELECTRO-OPTICAL TECHNIQUES FOR THE SAMPLING AND ANALYSIS OF AIR POLLUTANTS

W.F. Herget, U.S. Environmental Protection Agency, Office of Research & Development, Environmental Sciences Research Lab., *Research Triangle Park, North Carolina* 27711 (G712B-BA-006)

OBJECTIVE: Manage, administer, and conduct research on the application of electro-optical and electron optical instruments and systems for the measurement of pollutants emitted from stationary and mobile sources.

APPROACH: Remote sensing and extended-path techniques are applied for the identification of emitted gaseous pollutants. An electron microscope facility is maintained and applied for the characterization of particulate emission.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Sciences Research Lab.

5.0035, OHIO SOIL SURVEY

G. Hall, Ohio Agricultural Research & Development Center, *Wooster, Ohio* 44691 (0065341; OHO00450-S)

OBJECTIVE: Participate in Ohio Soil Survey program; explore and test new soil survey techniques; map soils on representative landscapes and characterize soil mapping limits; update soil survey on field research areas.

APPROACH: The cooperative program will be continued in the conduct of medium intensity soil surveys of new counties and old surveys will be evaluated as to their suitability for land use planning. Panchromatic and multispectral remote sensing techniques with surface mapping procedures will be tested as to

their feasibility for generalized and detailed mapping of soils in areas of different soil landscapes. Composition of soil mapping units and landscape features will be investigated. Soil surveys on field research areas will be reviewed and updated where needed.

PROGRESS: The Ohio Cooperative Soil Survey under the joint direction of the OARDC, ODNR Div. of Lands and Soils and USDA SCS has completed a modern land inventory of 4.5 of the 10.6 million hectares in the state (71%). During 1978 a total of slightly more than 0.4 million hectares of the state was mapped by field parties of the DLS and SCS. Soil survey field mapping has been completed in 51 of the 88 counties. Mapping is now in progress in 21 counties and a priority list established for the remaining 16 counties. Four counties in SE Ohio started progressive field mapping during the year: Perry, Scioto, Pike and Hocking. Cooperative soil survey reports for Greene, Miami and Portage counties were published during the year by USDA. Soil description and sampling for a soil drainability study to evaluate the effects of tile drainage on selected soils in NW and SW Ohio were completed during the year. This study, in cooperation with the OSU Dept. of Agricultural Engineering and the SCS, involved sampling the Clermont, Avonburg, Paulding, Latty and Roselms soils. Field studies in the Teays Valley area of Jackson Co. are being conducted by a graduate student in order to elucidate the origin of parent materials in the area.

SUPPORTED BY Ohio State Government

5.0036, PRECISE ESTIMATE OF THE EARTH'S GRAVITY FIELD

R. Rapp, Ohio State University Research Foundation, *1314 Kinnear Rd., Columbus, Ohio* 43212 (DF582570; F19628-79-C-0027)

AF function - study factors affecting precise determination of earth's gravity field. Deficiency - lack of suitable technical data for aerospace systems requiring precise gravity input. Objective - improved position determination and inertial alignment. How research contributes - provides technology to collect and interpret improved gravity data derived from currently inaccessible terrestrial areas.

Study global height reference systems by examining the unification of the various leveling networks that exist in the world today in order to see if it is feasible to develop a common gravity anomaly basis. Additionally, satellite altimetry data taken over land masses will be investigated to determine if it is practical to interpret such data for gravitational field improvement.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0037, LOWER THERMOSPHERE WINDS

W.B. Hanson, University of Texas, Dallas Campus, School of Natural Science & Mathematics, Dept. of Physics, *P.O. Box 688, Richardson, Texas* 75080 (DF583600; F19628-79-C-0113)

AF function - airborne surveillance, target acquisition. Deficiency - atmospheric density variations with time and space cannot be predicted with sufficient accuracy. Objective - direct measurement of neutral wind motions by satellite-borne accelerometers. Correlation of these results is made with other satellite data, including accelerometer density measurements, to develop improved atmospheric models. How research contributes - permits accurate determination of Air Force satellite ephemerides and development of accurate density forecasting techniques.

A satellite triaxial accelerometer system was flown on the Atmosphere Explorer-C satellite. Atmospheric density measurements have been derived from the two axes oriented to see large components of the force due to air drag. The third accelerometer axis was always nearly perpendicular to the air drag direction. Forces due to atmospheric winds along this axis may be determined. Separation of wind data from other forces acting on this axis is required. The other forces include those due to vehicle dynamics, motions of other instruments on the satellite and a small component of air drag if the accelerometer axis is not exactly orthogonal to the drag vector. This study will determine the accuracy with which neutral winds can be measured as a function of satellite altitude.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, STRESS AND PERFORMANCE IN THE FLYING TRAINING ENVIRONMENT

Kuhlenkasl, Arizona State University, Graduate School, *Tempe, Arizona* 85281 (DF224200; F33615-78-C-0053)

To investigate stress in the flying training environment with particular interest directed to stress of simulated flight and subsequent stress of airborne events. Experiments have been planned which (1) allow for quantification of stress experienced in various modes and phases of surface attack training, (2) help determine the interaction of instructor techniques and student stress, and (3) provide a clearer picture of the relationship between stress, learning and performance in surface attack training.

Three studies will examine: (1) physiological indices of stress in A-10 surface attack training, (2) the effect of IP teaching style on student stress, and (3) the effect of combat experience on stress response to simulated A-10 scenarios.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0002, ADVANCED FIGHTER RESEARCH PLANNING

W.L. Waag, U.S. Dept. of Defense, Air Force, Human Resources Lab., *Williams Air Force Base, Chandler, Arizona* 85224 (DF224280)

To define critical research issues which impact the design of advanced fighter training systems and to develop a plan which addresses these research issues using the modified capabilities of the ASPT. It is anticipated that the research program will focus on training syllabus development, performance measurement development, visual and force cue requirements, and instructor-operator station design requirements with emphasis on those features unique to the F16 aircraft.

A research team within FT shall be formed for the development of the research plan and shall take into consideration status of the F16 training system, projected ASPT capabilities and engineering development schedules, and user organizations requiring information which might be provided as a result of the research effort. Following formation of the research team and its orientation to the weapons system, user organizations shall be contacted for the purpose of identifying a potential set of research issues. From these data, a preliminary research plan shall be drafted and a planning conference hosted for their revision. Based on these revisions, the draft plan shall be forwarded to participating organizations for final review. The final plan shall become the basis of the research program to be accomplished using the ASPT.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0003, TACTICAL PERFORMANCE CHARACTERIZATION

L.J. Fogel, Decision Science Inc., *4901 Morena Blvd., San Diego, California* 92117 (DF228490; F33615-78-C-0011)

To develop advanced techniques for characterizing important aspects of tactical performance in flight simulators for display at the instructor/operator station (IOS). The work will include development and testing of methods for quantifying the value of importance assigned by students to various performance criteria and to the acquisition of various vantage points in the maneuvering envelope. This type of information, when displayed at the IOS, will provide valuable training data not otherwise available through conventional displays.

An adaptive maneuvering logic (AML) program has been developed to emulate the opponent in one-on-one tactical combat. The approach is to develop a modification of this pro-

gram which can compute the subjective weights assigned by a student to various short- and long-term performance goals or tactical objectives. The first phase of the study will be to develop and demonstrate the mechanics of the necessary computations - 9 MAC. The second phase, to be conducted only upon successful completion of the first phase, will include demonstration/refinement of the method using real pilot data recorded on the air combat maneuvering range - 15 MAC.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0004, AIRCRAFT OXYGEN GENERATION BY MEMBRANE PERMEATION

D. Johnson, Garrett Corp., *2525 W. 190th St., Torrance, California* 90509 (DF324890; F33615-79-C-0609)

This effort is to design, construct and test a staged gas permeation system to demonstrate the technical feasibility of producing aviator's breathing oxygen from aircraft engine bleed air.

The use of membrane gas permeators offers an alternative technology for on-board generation of breathing oxygen, which may offer the advantage of 100 percent contaminant-free oxygen coupled with a low aircraft power penalty. Various types of membranes will be investigated for oxygen permeation. Based on these data, a model system is to be constructed capable of delivering 20 liters/minute of 90 percent oxygen and to determine the effect of operating parameters such as feed pressure, temperature, and flow on oxygen concentrations. In addition, recommendations are to be included for up-grading the oxygen system to a prototype configuration which must provide 95 to 99 percent oxygen at flow rates up to 40 liters/minute.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0005, WIND-BLAST PROTECTION CONCEPTS DEMONSTRATION

W. Adams, Rockwell International Corp., *International Airport, Los Angeles, California* (DF325420; F33615-79-C-0528)

Injury statistics from combat and non-combat emergency escape experience with USAF and USN ejection seats indicate that wind-blast injuries greatly degrade the effectiveness of these systems to provide safe recovery of aircrew. Injuries to the legs and arms present the most frequent serious problem. The objective of this research effort is to develop and demonstrate by limited testing the feasibility of limb protection concepts that are suitable for use with current in-service ejection seats. Resulting aeromedical design criteria and data will be provided to the Aeronautical Systems Division for further development and testing, and introduction of the final wind-blast protection equipment into operational usage.

This research effort encompasses: 1. exploratory development of new wind-blast protection techniques and equipment configurations, 2. demonstration of protective equipment concepts by laboratory tests, and 3. the development of aeromedical design criteria for wind-blast protection systems. To assure applicability of the research effort, the ACES II ejection seat will be used as the baseline seat design for this study. The protective system design will be compatible with the general installation requirements of the A-10, F-15, F-16 and their two-seat configurations. Consideration of designs from Air Force contract F33615-78-C-0514 will be given greatest emphasis. The research effort will be coordinated with the ASD Life Support Systems program office and aircraft program offices to assure that the design data and criteria that are developed can be successfully transitioned into protective equipment hardware development programs that will meet operational user needs.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0006, DYNAMICS OF AIRCRAFT ACCIDENT VICTIMS - COMPUTER SIMULATION

J.M. Ballo, U.S. Dept. of Defense, Armed Forces Inst. of Pathology, *c/o Walter Reed Medical Ctr., Washington, District of Columbia* 20306 (DAOB6608)

Computer simulation of the kinematics of occupants in selected aircraft accidents in order to recreate the sequences of injuries and to determine their specific cause(s). This will lead to an increased understanding of the pathogenesis of such injuries and lead to more effective means of preventing them. Examine feasibility of running concurrently the KRASH vehicle impact simulation code so as to enhance the realism of occupant-vehicle interaction.

APPROACH: Operate the CALSPAN three-dimensional program as a model using selected Aerospace Pathology Division cases as sources of input data. Correlate the actual injuries observed at autopsy with the injuries predicted from the occupant kinematics of the computer simulation. Use the optimal output features of the CALSPAN code, using subroutines to calculate injury severity indices and time points of maximum injury.

PROGRESS: The usefulness of the CALSPAN three-dimensional program model has been demonstrated for three primary situations. These are: (1) low-velocity fixed-wing aircraft accidents; (2) rotary winged aircraft accidents; (3) out-of-envelope ejections with partial man-seat separation. The need for improvement of the program centers about three areas: (1) the need for a simplified input deck with greater flexibility in selection of altitude; (2) the need for post-processing for analysis of injury data; and (3) the need for a programmable deformation of the 'vehicle' during a crash pulse. The CALSPAN three-dimensional program model, in its present form, is more useful as a research and development tool rather than a day-to-day tool for the investigation of routine accidents.

SUPPORTED BY U.S. Dept. of Defense, Armed Forces Inst. of Pathology

6.0007, ASSESSING PEER RATINGS

Dunnette, Personnel Decisions Research Inst. Inc., *821 Marquette Ave., Minneapolis, Minnesota* 55402 (DF233440; F33615-78-C-0041)

To assess the relationship between peer ratings of new enlistees and their relative success in the Air Force.

The peer ratings, biographic and aptitudinal information on about 20,000 basic trainees will be codified into a tape file. From this tape file, the contractor will perform statistical analyses to assess the ability of peer ratings to predict success in basic military training (BMT). It is estimated that this effort will take 12 months. The final product will be a technical report.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0008, AN EXPERIENCE-JUDGMENT APPROACH TO TACTICAL FLIGHT TRAINING

R.P. Meyer, Design Plus, *St. Louis, Missouri* (DF054660; F49620-79-C-0052)

AF function - this research supports AF programs in aircrew training, particularly the training of critical combat skills in the tactical arena, and supports the AF Simulator Procurement Program. Deficiency - the basic principles of learning which are needed to design effective visual simulators for training tactical flying skills are only partly known. Without research in this area, visual scene modeling for tactical simulation will fall short of its potential training effectiveness. Objective - the objective of this research is to discover visual simulations which are highly effective for teaching critical tactical flying skills. How research contributes - this research will uncover new concepts in visual simulation which can be used by instructional theorists and systems designers for creating tactical training materials.

The principal investigator will catalog old visual training materials currently used for tactical training. A taxonomy of tactical flying skills will be employed to determine whether these materials are adequate for all of the required tasks. A second inventory will determine what critical combat skills are not being taught in on-going flying programs due to risk. Then, existing visual materials which could train these tasks will be indexed. Tasks for which visual materials are needed, or current materials need improving, will be identified, and innovative scene modeling concepts will be used to build candidate scenes for training these tasks.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0009, ADVANCED TRAINING TECHNIQUES USING COMPUTER-GENERATED IMAGERY
D.R. Coblitz, McDonnell Douglas Electronics Co., *St. Charles, Missouri* (DF055000; F49620-79-C-0067)

AF function - this research supports Air Force programs in flight and technical training. Deficiency - the Air Force is making significant investments in computer-generated imagery systems for use in training environments, such as flight simulator visual systems. To make optimum use of these systems, more must be known about different types of scene modeling which can result in effective training for complex skill learning. Objective - the objective of this research is to investigate new concepts of computer-generated imagery which can be used effectively in training. How research contributes - this research will expand the use of computer-generated imagery systems in flight and technical training. It could significantly increase the number of skill categories which are now practiced using such systems.

Several training tasks from advanced flying programs will be studied, especially those involving combat skills, and tasks which might benefit from innovative scene modeling will be dissected into meaningful segments. Concepts using unique visual models will be investigated in the context of these task segments to see if training methods can be developed which provide cues that may not be available in the real world but which may add significantly to the speed, quality, or scope of the training transfer. These concepts will be refined and tested in an aircrew training environment.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0010, TRAINING EFFICIENT MULTIPLE-TASK PROCESSING STRATEGIES
D.L. Damos, State University of New York, Albany Campus, Graduate School, *1400 Washington Ave., Albany, New York* 12203 (DF053800; AFOSR-79-0014)

AF function - this research supports aircrew training programs, particularly the learning and performance of the types of skills characteristic of combat. Deficiency - modern weapon systems performing in combat-intensive environments place high demands on the aircrew. While some details of how the pilot learns to process information under stress are known, our knowledge of how to train information-processing skills remains deficient. Objective - this research will study ways to train pilots to resist information-processing stress. How research contributes - the results of this effort will feed into aircrew training technology, with potential impact on the structure and context of training programs.

The proposed effort covers a four-year period of investigation. The initial year will involve two experiments, both using a dual short-term memory and classification task. If individual strategy preferences can be detected, then operators will be trained to see if they can learn a non-preferred strategy, i.e., to determine their capability to learn new strategies. If operators can change their strategies, the second experiment will study efficient methods for training these new strategies. These methods will include adaptive training, pre-training, feedback manipulation, and instruction-demonstration.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0011, ASSESSMENT OF SCENE COMPLEXITY AND CUE VALIDITY IN VISUAL FLIGHT SIMULATION
H.G. Shulman, Ohio State University, Columbus Campus, School of Arts & Sciences, Dept. of Psychology, *190 N. Oval Dr., Columbus, Ohio* 43210 (DF055140; F49620-79-C-0070)

AF function - this research supports Air Force programs in aircrew training, especially flight simulator technology. Deficiency -computer-generated image systems allow many different visual scenes to be presented to pilots flying in sophisticated simulators. Little is known about which scene features are most important to achieve high levels of training transfer. Furthermore, there is no adequate measure of scene compleaity to use to describe different scenes. Objective -this research has two objectives. It will study earlier attempts to measure scene complexity and develop a valid metric for use by training researchers and it will develop the methodology for assessing the importance of different scene features for training various flying tasks. How research contributes - this research will provide useful methodological tools which researchers in training simulation can use to develop optimum visual simulations for aircrews.

Two research tasks will be pursued. 1. The human visual system will be assumed to analyze information about the distribution of spatial frequencies in a scene by using autocorrelations. A method will be developed for calculating autocorrelations for a given scene and relating them to human performance on tasks which are relevant to simulated and actual flight. If a strong relationship is established between this metric and performance, then it can be used to establish training efficiency, along a continuum anchored by simplified schematic images on one end and high detail, realistic images on the other. 2. The principal task of a pilot using terrain features in controlling his vehicle is assumed to be the use of key transformations in the visual scene for determining depth, altitude, speed, vertical velocity, etc. Using an interactive visual flight simulator, the research team will try to isolate these transformations and develop custom-tailored visual scenes which speed the learning of transformations for students learning specific tasks.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0012, LDF-3, APPLICATION OF OPTIMAL ESTIMATION TECHNIQUES TO BIODYNAMIC IMPACT DATA
J.H. Raddin, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF325470)

Recent requirements for biodynamic testing have placed more stringent demands on test instrumentation and data analysis in order to provide accurate, non-ambiguous descriptions of body part motion to allow useful mathematical model formulations. Current experimental technique involves the use of inertial sensors and photographic instrumentation in order to provide data on body part motion. However, since the inertial instruments generally measure rate or acceleration, and the photographic instrumentation provides measurements of position, these data outputs have classically been analyzed separately with poor correspondence when compared. This deficiency has led to difficulties in relating data from experiments to mathematical models. The objective of this effort, therefore, will be to develop a technique to utilize all available information sources in order to derive the statistically optimum estimate of body part motion in both the translational and angular sense.

This effort will take advantage of well developed technology in the field of inertial guidance and adapt techniques for use in the biodynamic application, thus assuring a high potential return on investment. The basic technology of the optimal estimator or Kalman filter will be adapted to function as a data analysis tool for impact experiments using inertial and film-derived data. Equations will be developed to produce the optimal estimate of body position, velocity, and acceleration (both in a translational and angular sense) using data derived from biodynamic impact experiments carried out within AMRL. Independent sensors located at other points on the structure being measured will be utilized to assess the accuracy of the estimation technique. Information will also be gained from this effort to assess the relative advantages and disadvantages of the various approaches to angular and translational motion sensing. This information will be an inherent product of this effort since those information sources contributing most directly to an optimum estimate will be more heavily weighted in the mathematical model than will sensors which contribute relatively little information or contribute information which is provided more accurately by other information sources available in the experiment. The money will be put on contract F33615-76-C-0520 with Dynalectron Corporation, work unit 72311607 as an expansion of effort.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0013, SUBJECTIVE EFFECTS OF MULTI-AXIS OSCILLATING INERTIAL FORCE ENVIRONMENTS
R.W. Shoenberger, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF321240)

To investigate the subjective effects of whole-body vibration in the pitch, roll, and yaw axes and in multi-axis environments. Subjective response data are available for the three translational axes (x, y and z) and this effort will extend that knowledge to rotational vibrations and to environments with simultaneous oscillations in (or around) more than one axis. The information obtained will result in improved and expanded vibration criteria for evaluating aircrew exposure to operational multi-axis oscillating inertial force environments, and provide data for improved crew station design to alleviate adverse vibration effects.

Psychophysical measurement techniques (e.g., psychophysical matching and magnitude estimation) will be used to evaluate the severity of vibration inputs. Subjects will be exposed to single axis angular vibrations (pitch, roll and yaw) as well as combined multi-axis inputs in both translational and angular modes. Subjective intensity comparisons will be made using single axis translational vibrations (for which there are existing criteria) as comparison standards. Data analysis will provide assessment of the subjective effects of angular vibrations in relation to translational motion and techniques for evaluating the subjective intensity of multi-axis vibrations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0014, DEVELOPMENT AND EVALUATION OF CIG TECHNIQUES

W.L. Foley, U.S. Dept. of Defense, Air Force, Human Resources Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF228920)

The objective is to develop, implement and perform engineering tests of various potential improvements to CIG. This will include evaluation of non-linear terrain generation methods, circular features techniques, new texturing methods, and new CIG concepts based on application of human perceptual characteristics. The effort will include informal but structured engineering evaluations and the development of refinements necessary to resolve problems.

For each of the four study areas listed in the objective, several tasks will be accomplished. First, evaluation techniques and criteria will be developed. Then the method under study will be implemented on the advanced CIG techniques evaluation (ACTE) system and subjects will be selected based on their CIG expertise and their familiarity with the real world cues being simulated. The ACTE system will be used to generate static and dynamic scenes which will be used in this effort, as well as in another study designed to examine in more detail the impact of the method on human performance. Finally, the scenes will be evaluated by the subjects using the selected criteria. As required, refinements and re-test will be accomplished prior to documentation of results.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0015, EFFECTS OF PROLONGED NOISE EXPOSURE - A LONGITUDINAL STUDY

S. Cohen, Oregon State Higher Education System, University of Oregon, School of Liberal Arts, Dept. of Psychology, *1472 Kincaid St., Eugene, Oregon* 97401 (BNS77-08576)

Laboratory research indicates that short-term exposure to environmental stress can be detrimental to task performance, and result in motivational and cognitive deficits. That research emphasizes acute rather than long-term effects. The present research deals with long-term effects of exposure to noise over long periods of time. The Principal Investigator investigates the effect of noise on the students in three schools near a busy airport. All three schools will be modified to reduce noise levels, but not all will be modified at the same time. The research examines the effect of noise and the noise reduction on attentional focusing, ability to tune out distracting noise, verbal ability, expectancy of control, and health.

SUPPORTED BY U.S. National Science Foundation, Directorate for Biological Behavioral & Social Sciences, Div. of Behavioral & Neural Sciences

6.0016, EYE MOVEMENT AS AN INDICATOR OF VISUAL WORK OVERLOAD IN AIRCREW PERSONNEL

G.T. Chisum, U.S. Dept. of Defense, Navy, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate, *Warminster, Pennsylvania* 18974 (DN081176)

Virtual image devices are being developed to provide a means of displaying information to aircrew members under a head-out-of-the-cockpit attitude. The amount and type of information to be displayed and the specific schemes for presentation of the information are currently in the process of being proposed and investigated. A method of evaluating the alternatives is required. The objective of this work is to evaluate the use of eye movements as an objective, non-intrusive, non-interfering method of assessing the effect on performance of the alternatives regarding virtual image display information amounts and design. The method can then be used to provide the information which will give guidance in selecting the most suitable alternative for display of information. The method will also be useful for the evaluation of the complexity and optential efficiency of any visual environment.

Visual tasks which are complicated enough to permit demonstration of performance levels, but simple enough to be readily quantified for use in the validation of an objective measure of efficiency, will be selected. Eye movements during the peformance of the tasks will be monitored. The difficulty of the tasks will be varied. Number of detections, indentifications or tracking scores, depending on the task selected, will be recorded as a function of task difficulty. Eye movements will be recorded and correlated with the task difficulty and performance scores. The correlation score will provide an indication of the validity of the eye movement measure as a means of objectively measuring visual efficiency. Eye movements can then be used to assess other tasks, and to predict effect on performance of various task or display designs.

SUPPORTED BY U.S. Dept. of Defense, Navy

6.0017, SELECTION FOR PILOT TRAINING

H.E. Jensen, U.S. Dept. of Defense, Air Force, Human Resources Lab., *Brooks Air Force Base, San Antonio, Texas* 78235 (DF234200)

1. Norming of AFOQT. 2. Investigation of new measures to be used in pilot selection. 3. Validation of AFOQT, PAPAMS, and experimental measures against UPT, CCTS, and operational performance. 4. Identification of characteristics of superior pilots. 5. Evaluation of the effect of the Flight Screening Program on UPT performance.

AFOQT will be normed on AFA, AFROTC, and OTS samples. New perceptual and psychomotor measures including the portable automated pilot aptitude measurement system (PAPAMS) will be investigated to determine their relationship to performance in UPT, CCTS, and operational settings. Phase I - AFOQT-N and APD norming study evaluation of flight screening program. Phase II - experimental testing program. Phase III - collection of criterion performance data through UPT, CCTS, and after one year in an operational setting.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0018, PERSONNEL TECHNOLOGY - EFFECTS OF LIFE STRESS AND COPING SKILLS ON PERFORMANCE AND ORGANIZATIONAL EFFECTIVENESS

I.G. Sarason, University of Washington, School of Arts & Sciences, Dept. of Psychology, *Seattle, Washington* 98105 (DN575416; N00014-75-C-0905)

In developing personnel who will later be exposed to high levels of stress (e.g., aviators, submariners, UDT personnel), the Navy and MARCORPS are limited by gaps in our knowledge of the fundamental relationships among situational stressors, life stress, individuals' coping skills, and organizational effectiveness. This work unit is designed to clarify these relationships and experiment with various individual and organizational procedures for improving the ability to cope with stress in organizational contexts.

Earlier research has demonstrated that stress is associated with morbidity and with decreased performance in certain kinds of situations. This research is producing new measures designed

to assess organizational stress. The investigator is experimenting with various techniques for altering cognitive responses since these are hypothesized to be involved in mediating the deleterious effects of stress on performance. The initial experiments in civilian groups exposed to high levels of job stress (e.g., firemen), will, if successful, be extended to certain military groups working under high stress conditions.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, ANALYSIS AND MODELING OF INFORMATION HANDLING TASKS IN SUPERVISORY CONTROL OF ADVANCED AIRCRAFT

R. Sheh, Perceptronics Inc., *6271 Variel Ave., Woodland Hills, California* 91364 (DF055730; F49620-79-C-0130)

AF function - increasing supervisory loads are being imposed on the pilot in advanced aircraft operations. Future aircraft will be characterized by high information loads, severe time constraints, and complex decisions regarding allocation of display resources. Deficiency - the information costs and the limited processing capabilities of the human operator make it necessary to optimize the information selected, processed and displayed. Objective - the research will establish new techniques for the selection of essential information in airborne tactical operations. How research contributes - the program will result in aids for the real-time analysis and management of information selection in advanced aircraft.

The techniques will center on the use of multi-attribute utility models, adaptive estimation methods, and queuing theory formulation to model individual supervisory control behavior. Specifically, the research will: (1) formulate a working taxonomy of supervisory control functions in advanced aircraft operations, (2) investigate the behavioral issues of operator acceptance of and confidence with the possible levels of model-based aiding, (3) generalize the model form to include continuous monitoring and control functions, and (4) produce guidelines for field applications of the information evaluation and management programs in operational airborne systems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0002, APPLIED PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL ANALYSIS

S.J. Osher, University of California, Los Angeles Campus, School of Letters & Science, Dept. of Mathematics, *405 Hilgard Ave., Los Angeles, California* 90024 (MCS78-01252)

Renewal of MCS-7604412.

This research concerns partial differential equations of hyperbolic type and of mixed type, with strong emphasis on their numerical solution. For hyperbolic problems the investigator will study non-linear instability, propagation of error, and the effects of boundaries. For mixed type problems he will deal with a method effectively of splitting the problem into separate elliptic and hyperbolic problems. Along the line of non-numerical work, the investigator will continue study of well-posedness and regularity for hyperbolic differential equations. He may also extend his recent analysis of certain equations of mixed type to those of transonic flow.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Mathematical & Computer Sciences

7.0003, RESEARCH IN ALGEBRAIC MANIPULATION

J. Moses, Massachusetts Inst. of Technology, School of Engineering, Dept. of Electrical Engineering & Computer Science, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (DF056340; F49620-79-C-0200)

AF function - design of aerospace vehicles. Deficiency - algebraic manipulation is still primarily done with pencil and paper. Objective -to improve capabilities for algebraic type manipulation on a computer. How work contributes - by reducing computer time and memory requirements.

Often the final answer is a short expression while intermediate expressions are long, as for example in obtaining the multivariate polynomial greatest common divisor used in simplifying rational functions. The proposed research builds on the idea that the information required may be a particular term or the polynomial may be sparse. For example, random values inserted for all but one of the variables map a difficult problem into a simpler one which however retains features of the full problem unless accidental cancellations occur. The probability of this occurring can be estimated and reduced. By solving a hierarchy of such simpler equations, using the information obtained along the way, much more effective algorithms can be obtained. Computer time is a polynomial function of the number of terms of the solution polynomial instead of exponential in the order of the solution polynomial. Intermediate expression swell is also reduced.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0004, DATCOM UTILIZATION AND IMPROVEMENT

J.E. Williams, McDonnell Douglas Astronautics Co., *E. 411 St., St. Louis, Missouri* 63166 (DF141500; F33615-78-C-3610)

A continuing effort is required to improve DATCOM coverage by refining existing methods and adding new techniques in concert with rapidly advancing technology. The objective of this effort is to determine the major shortcomings of DATCOM as it applies to modern design trends and to investigate potential means of overcoming these weaknesses. A uniformly valid and complete set of prediction methods which could be used with confidence in early design would eliminate much of the uncertainty and consequent expense now associated with this phase of design.

The digital DATCOM will be used to conduct parametric studies of modern configurations, thereby assessing the value of existing DATCOM methods and the relative value of various factors involved in the calculations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, ELECTRON MICROSCOPY OF ATOM CONFIGURATIONS IN FAULTED CRYSTALS

S. Iijima, Arizona State University, School of Liberal Arts, Dept. of Physics, *Tempe, Arizona* 85281 (DMR78-09291)

This research will be a study of defects in complex inorganic crystals using high resolution electron microscopy (HREM). Results of this work will be of importance to a number of areas of ceramic science, since many fundamental properties depend on the detailed nature of lattice defects. The research objectives will be two-fold: (a) to determine the nature of extended defects, such as planar faults, in complex oxides and other compounds, and (b) to continue improving the performance of present electron microscopes by refining the resolution capability even further. Theoretical interpretation of HREM images that are recorded under precisely controlled operating conditions will allow detailed comparisons to be made between experimental image contrast and contrast determined by computer simulation.

Additional research will include attempts to examine extremely small clusters of metal atoms which are prepared on thin graphite films, and to initiate studies using HREM to examine the structure of amorphous solids.

This program is a continuation of research initiated under NSF Grant DMR76-06108 A02.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0002, ORGANIC AND ORGANO-METALLIC CONDUCTORS AND SUPERCONDUCTORS
W.A. Little, Stanford University, School of Humanities & Sciences, Dept. of Physics, *Stanford, California* 94305 (DMR76-82087 A02)

The overall goal of this project is to advance our knowledge of the solid-state physics and chemistry of compounds containing strongly interacting substructures so their physical properties can be understood, designed and predicted. Part of this work is concerned with the broad question of the attainability of high-temperature superconductivity through systematic study of linear chain compounds. This includes the synthesis of polarizable ligand systems, plus model studies of stacked arrays of square planar complexes and the effects of oxidation upon them. Physical properties are measured and studies made of theoretical problems bearing on high Tc (critical temperature) materials.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0003, SPECTROSCOPY AND QUANTUM ELECTRONICS
A.L. Schawlow, Stanford University, School of Humanities & Sciences, Dept. of Physics, *Stanford, California* 94305 (PHY77-09687 A02)

The application of modern optical devices, such as advanced kinds of lasers, is proposed for basic studies in physics. In the course of these studies, the laser techniques will be refined and extended, and new sensitive methods of laser spectroscopy will be explored and developed. The extremely high resolution permitted by the techniques of Doppler-free nonlinear spectroscopy (saturation, polarization, two-photon) will be used to study fine and hyperfine structures in spectra of atoms and simple molecules. Use of short laser pulses in new ways for high-resolution spectroscopy and the extension of high-resolution methods to shorter ultraviolet wavelengths are planned. The spectrum of simple one-electron atoms will be studied in high resolution, to probe the limits of quantum electrodynamics, and to improve the values of fundamental constants. Saturation and polarization labeling techniques will be used and extended to simplify the analysis of complex atomic and molecular spectra. New techniques for measuring wavelengths and frequency intervals will be developed and studied. Laser methods for the ultrasensitive and highly selective detection of atoms and molecules will be explored. The development of a dye-laser-like tunable ultraviolet laser, pumped by a molecular hydrogen laser, which would be a valuable tool for laser studies of atoms and molecules, is also planned.

This work is a continuation of that currently supported under NSF grant PHY74-14786A03.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0004, PLASMA COLLECTIVE ION ACCELERATION
A. Fisher, University of California, Irvine Campus, School of Physical Sciences, Dept. of Physics, *Irvine, California* 92664 (DN975487; N00014-79-C-0560)

The Navy needs quantitative information on methods to generate intense ion beams with energies up to 1 geV for directed energy applications, sources of intense radiation through impact with targets, new sources of energy via interaction with pellets, etc. The electron beam front collective acceleration of ions to be carried out in this contract has the scaling characteristics which are necessary to fulfill the requirement stated above.

The beam front of a high current relativistic electron beam creates a very strong electric field capable of accelerating ions to geV energies over short distances. Controlling the motion of the electron beam front over distances of 10's of meters has been a major problem in the area of collective acceleration. In this contract, two novel concepts are utilized to accomplish this: (a) the use of a strong longitudinal magnetic field to maximize the length of propagation, and (b) the use of a programmed, externally generated plasma to provide the charge neutralization needed to propagate the space charge limited intense beam current front.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0005, ENGINEERING RESEARCH INITIATION - THEORETICAL INVESTIGATIONS OF RECOMBINATION CENTERS IN SEMICONDUCTORS
D. Pan, University of California, Los Angeles Campus, School of Engineering & Applied Science, Dept. of Electrical Sciences & Engineering, *405 Hilgard Ave., Los Angeles, California* 90024 (DMR78-05783)

This research will be a detailed theoretical investigation of two important problems about recombination centers in semiconductors. The first system which will be investigated is the hole recombination center of the two-electron impurity state of oxygen in gallium phosphide. The role of a complex structure, formed after the capture of the hole and before the recombination, will be studied in detail. The ground and excited states of this complex are of importance to determine various recombination mechanisms of quite different physical origin. Those states will be first studied in detail. The Auger recombination rates for those states will then be calculated. The recombination cross-section will be calculated in a cascade model. The result may shed new light about the mechanism of recombination centers which has many important technical applications. The second system to be investigated is the zinc-oxygen center in gallium phosphide light-emitting diodes (GaP LEDs). Various electronic states bound to Zn-O center will first be investigated. The potential energy as a function of the positions of Zn and O will be calculated in a simple model for various electronic states. The rate of 'dissociation' of the Zn-O pair will be estimated in a way similar to the theory of pre-dissociation of molecules.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0006, SOME THEORETICAL STUDIES OF THE PROPERTIES OF CONDENSED MATTER
P.A. Pincus, University of California, Los Angeles Campus, School of Letters & Science, Dept. of Physics, *405 Hilgard Ave., Los Angeles, California* 90024 (DMR78-10312)

Research previously supported by DMR7519544.

Theoretical research in condensed matter physics will be carried out. Some of the topics to be studied will include: quantal adiabatic hopping; hopping in the ultra-weak dispersion regime; hopping in a molecular crystal with Morse-type intramolecular vibrational potentials; higher-order multiphonon calculations; the mechanism of self-trapping of electrons, holes and excitons; excitation transfer in disordered systems; spin flip scattering near the glass transition in spin-glasses; magnetic anisotropy of strongly mixed magnetic moments in dilute magnetic alloys; fluctuations in superconductors near the critical temperature; macromolecular physics; polyelectrolytes; deformed entangled polymer solutions; and nematic polymers.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0007, THE ELECTRIC CURRENT STRUCTURE OF THE MAGNETOSPHERE AND HELIOSPHERE
H. Alfven, University of California, San Diego Campus, Graduate School, Dept. of Applied Physics & Information Science, *P.O. Box 109, La Jolla, California* 92037 (ATM79-17859)

This grant will continue studies of the current system in natural plasmas, paying attention to those effects which produce non-ideal plasma behavior, and examining the conditions for production of charge double layers and the collapse of volume

currents into sheets and filaments. A new initiative will be an effort relating these phenomena to observations of planetary and cometary magnetospheres and the heliosphere, while noting in each case the topological constraints set by the continuity relations for current and field lines. The overall aim is to provide a theoretical framework for space plasma physics which will be both accurate and realistic.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

8.0008, IR BACKGROUND MEASUREMENTS

D. Murcray, University of Denver, School of Arts & Sciences, Dept. of Physics, *2115 S. University Blvd., Denver, Colorado* 80210 (DF582060; F19628-78-C-0164)

AF function - surveillance, target detection, discrimination and acquisition. Deficiency - lack of high-resolution spectral data of atmospheric background emission which reduces target to background contrast. Objective - obtain high-resolution IR spectral data of atmospheric background emission as a function of altitude, time of day and season - data which is needed for enhanced performance of present and future sensor systems used for target detection.

A 0.1 cm to the minus 1st power resolution LIN cooled interferometer and gondola package will be modified, such that the whole system will have elevation and azimuth pointing capability for down-looking as well as up-looking balloon measurements. This instrumentation will then be used to perform IR background emission measurements as indicated in objective.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

8.0009, THEORETICAL STUDIES ON SPIN GLASSES, ELECTRONS IN DISORDERED SYSTEMS, AND TWO-DIMENSIONAL PHASE TRANSITIONS

D.J. Thouless, Yale University, Graduate School, *206 Elm, New Haven, Connecticut* 06520 (DMR79-08329)

Theoretical research will be carried out on three topics: (1) Spin glasses, in which the nature of electron localization will be explored, and the details of phase transitions will be investigated - of particular interest will be the effect of an external field on the critical properties. (2) Electrons in disordered systems - the general problem of localization will be studied, in reference to the properties of disordered solids, such as maximum resistance, the Hall effect and the behavior of the conductivity in an external magnetic field. (3) Two-dimensional phase transitions - the consequences of the vortex driven transition (Kosterlitz-Thouless model) will be worked out. In particular, an explanation of the properties of helium films will be developed.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0010, HIGH-FIELD STUDIES OF SUPERCONDUCTING LAYERED COMPOUNDS

D.E. Prober, Yale University, School of Science, Dept. of Engineering & Applied Science, *206 Elm, New Haven, Connecticut* 06520 (DMR78-17957)

This is a continuation of the work sponsored under DMR76-09591 and entails an experimental study of the high magnetic field properties of superconducting transition-metal dichalcogenides layer compounds. A miniaturized high frequency resonant circuit has been designed and constructed which will allow one to measure Tc and Hc(T) of oriented microcrystallites (mass less than 1 microgram) of compounds of interest. These include TaS2 intercalated with long-chain amines, metallocene intercalated complexes and the unintercalated alloy series Nb1-xTaxSe2. This work is important for our understanding of the basic microscopic nature of the super-conducting state in these layered systems and has potential for impacting upon technologically important high-field superconductors in general.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0011, COMPUTER SIMULATIONS OF MAGNETIC SYSTEMS

D.P. Landau, University of Georgia, Franklin College of Arts & Sciences, Dept. of Physics & Astronomy, *Athens, Georgia* 30601 (DMR76-11329 A01)

Research previously supported by DMR76-11329.

Theoretical research in condensed matter physics will be carried out. The main thrust of the investigations will be to study the thermal and magnetic properties of magnetic systems using importance sampling Monte Carlo methods. Emphasis will be placed on the examination of models exhibiting multicritical phenomena in two and three dimensions. These studies will include the location of phase boundaries and multicritical points and an examination of the associated critical and multicritical behavior. More detailed studies of 'impure' and 'random' systems will be pursued and investigations of models with long-range interactions will continue. The low temperature behavior of these models will be studied using the new 'n-fold way' algorithm.

This research will help to illuminate the behavior of a material which is changing phase and will be particularly useful in circumstances where the more analytical theories do not apply.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0012, EXCHANGE PROPERTIES OF SOLID 3HE, ACOUSTIC AND NMR STUDIES OF THE 3HE SUPERFLUIDS

W.P. Halperin, Northwestern University, Evanston Campus, School of Arts & Sciences, Dept. of Physics & Astronomy, *633 Clark St., Evanston, Illinois* 60201 (DMR78-11660)

Measurements of the susceptibility, phase diagram, pressure effects, antiferromagnetic resonance and specific heat of solid helium-3 will be performed in order to explore the exchange magnetism in the BCC phase. Acoustic impedance measurements will be made in the A and B phase of superfluid helium-3. Longitudinal magnetic resonance frequencies will also be measured over a wide range of temperature and pressure. The g-shift in the B phase and relaxation in both phases will be studied. This work is important to understanding the behavior of quantum solids.

This is the first year of a three-year continuing grant. Research previously supported under DMR-7605181.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0013, THE EFFECT OF A ZERO G ENVIRONMENT ON FLAMMABILITY LIMITS AS DETERMINED USING A STANDARD FLAMMABILITY TUBE APPARATUS

R.A. Strehlow, University of Illinois, Urbana Champaign Campus, School of Engineering, Dept. of Aeronautical & Astronautical Engineering, *207 Engineering Hall, Urbana, Illinois* 61801 (NSG 3293)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

8.0014, INTERDISCIPLINARY PROGRAM OF MATERIALS RESEARCH

C.P. Flynn, University of Illinois, Urbana Champaign Campus, School of Liberal Arts & Sciences, Dept. of Physics, *Urbana, Illinois* 61801 (DMR77-23999)

Major interdisciplinary programs are being pursued in three areas. The effects of structure modulation are studied in Microscopically Modulated Materials, where theoretical and experimental investigations of property variation are being carried out. Of special interest are the effects on the fluctuations, on mor-

phology and dynamics of phase transitions, and on the control of the resulting properties.

The program on Optical Semiconductors emphasizes the quaternary system In-Ga-As-P, in which materials exhibiting a large range of band gap width can be prepared. Such materials can be used in optical devices tuned to selected wavelength.

The program on Compound Catalysts emphasizes non-metallic catalysts, and is currently primarily concerned with the theory of surfaces. The development of instrumentation for proving the properties of clean and of doped surfaces is the initial objective.

Significant support is provided for the operation of central facilities and for additional research on liquids, on disordered solids, and on structural alloys. Close coordination with a research program co-supported by the Department of Energy is maintained locally.

This award is a continuation of DMR76-01058 A01 and is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0015, RESEARCH IN NUCLEAR ASTROPHYSICS
J.W. Truran, University of Illinois, Urbana Champaign Campus, School of Liberal Arts & Sciences, Dept. of Physics, *Urbana, Illinois* 61801 (AST78-20123)

The research to be carried out in this grant will be primarily concerned with two broad topics in nuclear astrophysics: (1) the mechanisms by which heavy nuclei are formed in stellar interiors, novae, and supernovae, and (2) the consequences of mass accretion onto white dwarf stars in aging binary systems. Detailed calculations have shown that the composition of matter ejected in nova and supernova explosions is consistent with the abundances of material in the solar system. It has also been demonstrated that luminous and rapidly evolving red giant stars are also the formation site of a class of heavy nuclei ranging from the heaviest isotopes of iron through mercury and lead. Nova explosions have been shown to result from the accretion of hydrogen-rich material onto the surfaces of white dwarf stars in binary systems.

Studies which will be carried out include: (1) studies of the hydrodynamics of nova explosions; (2) the accretion of matter onto white dwarf stars; (3) the synthesis of elements in the outer atmosphere of a supernova; (4) the synthesis of elements in the interiors of red giant stars; (5) the formation of dust grains in novae and supernovae; and (6) the behavior of neutron star matter at high temperatures and densities.

This is a continuation of research previously supported under NSF grant AST77-21563.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

8.0016, HISTORY OF PLANETARY PHYSICS
S.G. Brush, University of Maryland, College Park Campus, Inst. for Physical Science & Technology, *College Park, Maryland* 20742 (SOC77-26749)

Dr. Brush is conducting historical research in the area of nineteenth and twentieth century geophysics and astrophysics, with special emphasis on the connections of these sciences with the so-called 'fundamental' parts of physical science (atomic theory, thermodynamics, electromagnetism, relativity). In addition to publications on the history of planetary physics, he expects that the project will ultimately lead to a book on the history of modern physical science in which the development of planetary physics and its relations to other disciplines are included.

Dr. Brush is currently concentrating on a detailed study of changes in ideas about the early development and internal constitution of the earth since 1830, and on the development of astrophysical, geological and chemical sciences relating to theories of the origin of the solar system in the twentieth century. He is examining aspects such as the impact of discoveries in celestial mechanics, radioactivity, and seismology, reasons for the rejection and later revival of ideas such as nebular origin of the solar system, planetesimal hypothesis, fluid regions inside the earth, and continental drift; and the interactions of scientific disciplines such as astronomy, physics, geology, chemistry and applied mathematics.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Biological Behavioral & Social Sciences, Div. of Social & Economic Science

8.0017, MAGNETIC RESONANCE IN IONIC SOLIDS
I.Y. Chan, Brandeis University, School of Arts & Sciences, Dept. of Chemistry, *415 South St., Waltham, Massachusetts* 02154 (DMR74-18095 A01)

Electron nuclear double resonance (ENDOR) of 19F is used to investigate the behavior of Jahn-Teller active ions in fluorite crystals. Vibronic interaction in such species leads to characteristic modification of hyperfine interaction of the F nuclei with the electronic system of the center ions. Precise measurements of the hyperfine interaction constants by ENDOR in turn provide information of the Jahn-Teller active system. Specific objectives are to: 1. Continue and complete ENDOR studies of the Cu2 ion:CdF2 system. ENDOR frequencies as a function of magnet angle are measured along three independent planes. Hyperfine coupling constants are extracted by least squares methods. The distorted geometry of this static Jahn-Teller system will be deduced from the dipole model. The nature of the Jahn-Teller active vibrational mode will be elucidated. 2. Test the feasibility of an ENDOR experiment on the Fe2 ion:KMgF3 system based on the double quantum EPR transition. A measurement of the hyperfine constants in this dynamic Jahn-Teller system will provide information on orbital reduction.

This is a continuation of research supported under DMR 74-18095.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0018, ANALYTICAL METHODS IN MANY-BODY PHYSICS
E.P. Gross, Brandeis University, School of Arts & Sciences, Dept. of Physics, *415 South St., Waltham, Massachusetts* 02154 (DMR76-02048 A01)

Research previously supported by DMR76-02048.

Theoretical research in condensed matter physics will be performed which is designed to develop and improve mathematical approximations in the physics of many-body systems and in the study of particle field and random potential interactions. Techniques which have been developed in the theory of the dynamics of classical dense gases, liquids and plasmas will be extended to apply to general many-body systems. The theory of particle field and random potential interactions will be developed, with the aim of finding a systematic theory for the strong and intermediate coupling domains comparable to the existing theory for weak coupling.

The aim of this research is to increase our understanding of the fundamental interactions which determine the behavior of condensed matter.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0019, FUNDAMENTALS OF MAGNETIC INTERACTIONS - NEW APPROACHES TO THEORY AND EXPERIMENT
A. Lempicki, General Telephone & Electronics Corp., G T E Laboratories Inc, *40 Sylvan Rd., Waltham, Massachusetts* 02154 (DF056180; F49620-79-C-0182)

AF function - this proposed research primarily falls in the 7.4 research objectives which deal with the theoretical and experimental investigations of electronic, optical, acoustic, thermal, magnetic and conducting properties of materials to evolve new and improved device concepts. In particular, this is an extensive experimental and theoretical investigation directed at elucidating the fundamentals of magnetic interactions and light-

induced magnetic phase transitions. Deficiency - a wide range of basic research efforts that support the development of devices and device concepts are needed for the application of contemporary electronic electromagnetic technology in the operational Air Force. Most studies of magnetic properties utilize model Hamiltonians, and model potentials which are incorrect on first principles considerations. Objective - the major emphasis will be on achieving a light-induced magnetic phase change and an extensive fundamental calculation aimed at a complete qualitative prediction of the magnetic structure. Contribution - this research is part of a comprehensive program in statistical mechanics to study phase transitions.

The main goal of this research is a complete understanding of the nature of the coupling of the electronic spins, both orbital and intrinsic angular momenta, which give rise to the phenomena of cooperative magnetism. This does not exist at this time for any material. Light offers a sharp probe of magnetic interactions in certain magnetic semiconductors, insulators and certain rare-earth metals that have magnetism highly sensitive to external influences. It can alter electronic spins directly, and alter populations of electronic states responsible for the coupling which is called opto-magnetism. It is proposed to combine a team of physicists, from industry and universities, to obtain just the aforementioned understanding of magnetism.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0020, PROPERTIES OF AMORPHOUS SEMICONDUCTORS

W. Paul, Harvard University, Cambridge Campus, School of Arts & Sciences, Dept. of Engineering & Applied Physics, *Cambridge Station, Cambridge, Massachusetts* 02138 (DMR78-10014)

This a continuation of research previously supported by NSF grant DMR-7615325.

Samples of amorphous group 4 and group 3-5 semiconductors with incorporated hydrogen and other dopants will be prepared and characterized chemically and structurally. Appropriate property measurements, among them photoluminescence, electron spin resonance, optical and transport, will be carried out and correlated in order to gain a comprehensive, self-consistent model of the behavior of the substance. Special attention will be paid to the possibility that strong electron-phonon interactions affect the optical properties through developing Stokes shifts and the transport properties through the creation of small polarons. Measurements made as functions of the hydrogen content of the films will be done in order to try to separate out the intrinsic properties of the disordered element or compound from those of the alloy with hydrogen. In the case of the binary compounds, special attention will be paid to the effects of like-atom bonds in determining the properties.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0021, ELECTRONIC STATES IN DISORDERED MATERIALS

A. Bansil, Northeastern University, College of Arts & Sciences, Dept. of Physics, *360 Huntington Ave., Boston, Massachusetts* 02115 (DMR79-02600)

The research to be performed will focus on the equilibrium electronic properties of disordered metals. The materials to be studied include noble and transition metal alloys and metallic glasses.

The disordered alloys will be investigated within the framework of the coherent potential (CPA) and the average t-matrix approximations (ATA), utilizing realistic muffin-tin potentials to represent the atoms. The question of calculating self-consistently charge densities and atomic potentials in transition and noble metal alloys will be studied. The extentions of the theory to obtain average momentum densities, measured by a Compton scattering or a positron annihilation experiment, will be taken up.

The theory will also be used to study the electronic spectrum of liquid metals and metallic glasses. The latter materials have many potential technological applications. In recent years a substantial body of experimental optical, photoemission, specific heat, magnetic susceptibility, Hall effect and residual resistivity data on liquid and amorphous metals has become available. The extent to which these data can be correlated within the present scheme will be investigated. This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0022, DEVIATIONS FROM MATTHIESSEN'S RULE IN THE ELECTRICAL RESISTIVITY AND ATTENDANT EFFECTS IN OTHER TRANSPORT PROPERTIES (ABBREV)

R.I. Boughton, Northeastern University, School of Liberal Arts, Dept. of Physics, *360 Huntington Ave., Boston, Massachusetts* 02115 (DMR77-24023)

This is a continuation of the research previously supported by DMR-7513090.

The experimental research program consists of two parts. The first and major portion involves a series of measurements of the electrical resistivity in a specific group of polyvalent metals which exhibit large and systematic deviations from Matthiessen's rule which are not at present adequately described by theory. Definitive experimental tests of the 'Non-conservation of Momentum' theory will be carried out by studying the correlations between impurity scattering-induced deviations in the electrical resistivity with boundary scattering-induced deviations and deviations in the thermal resistivity, respectively. The second part of the research program entails a continuation of the investigation of the possibility of observing flux quantization in a normal metal through measurement of the Aharonov-Bohm effect.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0023, COHERENT FAR INFRARED SOURCES AND NONLINEAR PROCESSES

F. Brown, Williams College, Graduate School, Dept. of Physics, *Williamstown, Massachusetts* 01267 (ENG77-20145)

This program consists of the development of a deuterium water vapor and the application of the laser to the investigation of nonlinear processes in crystals at far infrared wavelengths. Laser powers in the range between 25 and 40 megawatts will be sought for discrete wavelengths lying between 50 and 150 micrometers. The nonlinear processes to be investigated include Raman scattering by electronic states associated with impurities in germanium and the generation of intense terrahertz acoustic signals in gallium arsenide. The acoustic studies will also deal with the determination of damage thresholds at far infrared wavelengths.

This is a continuation of research previously supported under NSF grant ENG-7503222.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

8.0024, FUNDAMENTAL INVESTIGATIONS USING POSITRONS AND POSITRONIUM

A. Rich, University of Michigan, Ann Arbor Campus, School of Literature Science & the Arts, Dept. of Physics, *Ann Arbor, Michigan* 48104 (PHY77-28139)

Recent studies of the decay rate of ortho-positronium have shown a serious discrepancy with calculations based on current atomic theory. Further studies will be made of this decay rate in various environments (powder, gas, and vacuum). In addition, research will be initiated on the decay rate of para-positronium, on the allowed four-photon decay of positronium, and on the polarization of slow positron beams.

This is a continuation of work supported by NSF Grant PHY76-02398 A02.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0025, JOSEPHSON VORTEX PROPERTIES AND NONEQUILIBRIUM SUPERCONDUCTIVITY

J. Chen, Wayne State University, School of Liberal Arts, Dept. of Physics, *4841 Cass Ave., Detroit, Michigan* 48202 (DMR78-17813)

Research previously supported by DMR7402616.

A comprehensive experimental and theoretical investigation of nonequilibrium superconductivity in thin tin films as well as the electrodynamic properties of long Josephson tunnel junctions containing vortices will be made; techniques to be used include electron tunneling spectroscopy employing double junctions and ultrasonic attenuation measurements on thin films. Initial studies will concentrate on tin films and tin-tin oxide junctions. This work is important as the results will impact on emerging technologies such as ultrafast superconducting computers.

This is the first year of a two-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0026, NEUTRON SCATTERING STUDIES OF THE TRANSITION METAL SESQUIOXIDES

S.A. Werner, University of Missouri, Columbia Campus, Graduate School, *205 Jesse Hall, Columbia, Missouri* 65201 (DMR77-27247)

Neutron scattering experiments will be carried out at the University of Missouri Research Reactor to investigate the highly unusual magnetic and electronic properties of the vanadium and titanium oxides. Large single crystals suitable for neutron scattering experiments have been obtained and will be used in the following experiments: 1) Measurement of the phonon dispersion in V2O3 above and below the semiconductor-to-metal transition (170 degrees K). 2) Measurement of the magnon dispersion in V2O3 below the Neel temperature. 3) Measurement of the phonon dispersion in Ti2O3 as a function of temperature. 4) Measurements on chromium-doped V2O3 at temperatures where the speculated Mott transition occurs. 5) Measurements of the magnetic ordering in titanium-doped V2O3 as a function of temperature.

This is the first year of a two-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0027, COINCIDENCE AUGMENTED DIFFERENTIAL ION ENERGY-LOSS SPECTROMETRY

J.T. Park, University of Missouri, Rolla Campus, School of Science, Dept. of Physics, *Rolla, Missouri* 65401 (PHY78-07907)

This project in atomic physics studies the fundamental properties of the collisions of atoms at energies (up to 200 keV) well in excess of the atomic binding energies. A unique ion energy-loss spectrometer is used to measure the details of the collision process with a resolution of one part per million and better in energy, and simultaneously measure the scattering angles. It will be possible to measure the excitation of specific excited states in atomic hydrogen by incident protons, as well as the details of differential charge transfer scattering. In parallel, the collision products (including the photons emitted by excited atoms) will be detected. These studies will be extended to more complex atoms.

This is a continuation of work supported by NSF Grant PHY74-09671 A04.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0028, THEORETICAL STUDIES OF THE ELECTRON STRUCTURE OF SOLID SURFACES

J.C. Hermanson, Montana State University, School of Letters & Sciences, Dept. of Physics, *Bozeman, Montana* 59715 (DMR77-11862)

A theoretical model will be developed to examine the electronic structure of solid surfaces. The technique to be used will be an extension of the resolvent method which has been modified to treat a tight-binding model of solid surfaces. This method will be used to compute densities of states for the interpretation of the results of angle-resolved photoemission experiments on oriented single crystals. The initial aim of this work is to consider clean surfaces of solids, but a later objective will be the calculation of chemisorption behavior. This approach utilizes the best available band structure information and emphasizes the role of geometrical factors in determining surface quantum structure. Relaxation and reconstruction will be treated by modifying atomic interactions near the surface.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0029, ELECTRON CORRELATIONS AND PROPERTIES OF METALS AND INSULATORS

D.C. Langreth, Rutgers the State University of New Jersey, New Brunswick Campus, School of Arts & Sciences, Dept. of Physics, *Old Queens Bldg., New Brunswick, New Jersey* 08903 (DMR77-08694 A01)

Theoretical investigations of many-electron systems in condensed matter previously supported by NSF grant DMR-7509804 will be continued.

Specific topics to be addressed include: the effect of electron correlations near surfaces of metals, surface energy of metals, and related structural properties; exchange and correlation in non-uniform systems and the approximate methods used in them; real metal properties including magnetic effects; and high-energy excitations in solids, including the theory of high-energy probes of solids such as photon, photoelectron, and electron spectroscopies. These will be studied both with respect to bulk and surface properties.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0030, LOW TEMPERATURE THERMAL PROPERTIES OF AMORPHOUS SOLIDS AND NITRATE GLASSES

R.O. Pohl, Cornell University, Ithaca Campus, School of Arts & Sciences, Dept. of Physics, *Ithaca, New York* 14850 (DMR78-01560)

A systematic study of the thermal and dielectric properties of nitrate glasses at low temperatures will be carried out. This will include experimental measurements of the low temperature thermal conductivity and specific heat as well as of the optical and dielectric properties. Other amorphous and disordered solids exhibit anomalous behavior in their low temperature thermal and dielectric properties which may be characteristic of the disordered state. The goal of this research is to seek control of the anomalies in well prepared and well characterized nitrate glasses in order to identify those properties intrinsic to the amorphous state. A specific aim is to search for impurity modes in glasses associated with rotational or translational motion of impurity ions.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0031, THEORY OF CHARGE TRANSFER AT SEMICONDUCTOR-ELECTROLYTE INTERFACES

D. Mattis, Polytechnic Inst. of New York, Brooklyn Campus, School of Arts & Sciences, Dept. of Physics, *333 Jay St., Brooklyn, New York* 11201 (DN875508; N00014-78-C-0594)

Electrochemical processes at the semiconductor-electrolyte interface are important in many Navy areas of interest, includ-

ing photolysis of water, photovoltaic devices, corrosion and techniques for surface passivation of semiconductors. Improved devices and better control of many problems associated with electrochemical processes of surfaces will result from better understanding of the mechanisms associated with charge transfer and current flow at these interfaces.

The investigator is developing theoretical techniques to describe the charge exchange between semiconductor surfaces and adsorbed atoms. These will be applied to the charge transfer process occurring at the interface between a semiconductor and a liquid electrolyte while under illumination. Electronic eigenstates will be determined as will normal vibrational modes of the adatom. Other areas of application will be the interface between oxides and silicon and the compound semiconductors. Defect levels and resonant levels for tunneling mechanisms will be considered. Particular attention will be directed to the break-up of excitons impinging on the interface and its electron-ion analog in the photoelectrochemical cell problem.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0032, MULTIPLE X-RAY DIFFRACTION EFFECTS IN SINGLE CRYSTALS

B. Post, Polytechnic Inst. of New York, Brooklyn Campus, School of Science & Engineering, Dept. of Physics, *333 Jay St., Brooklyn, New York* 11201 (DMR77-02532 A01)

This investigation will be a study of the nature and techniques of multiple diffraction of X-rays by crystals, and the application to selected problems in materials science and solid-state science. The study will include highly precise lattice constants of crystals such as gallium arsenide, gadolinium gallium garnet, and magnetic oxides.

In addition, the experimental determination of phase relationships among X-ray reflections from single crystals will be made. This will be done by analyses of the intensity distributions in the X-ray fine structure of reflections recorded under conditions of multiple diffraction. The research will be broadened from the study of perfect crystals to less perfect crystals.

This is a continuation of research initiated under NSF Grant DMR75-23680.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0033, COMPUTATIONAL STUDY OF NONADIABATIC EFFECTS IN ATOM-MOLECULE REACTIVE SCATTERING

M. Redmon, Battelle Memorial Inst., Battelle Columbus Laboratories, *505 King Ave., Columbus, Ohio* 43201 (DF054510; F49620-79-C-0050)

AF function - Air Force operations in detection, surveillance, and other areas require knowledge of gas phase energy exchange mechanisms. Deficiency - there is a lack of detailed understanding of how energy transfer occurs between species in the atmosphere and in lasers. Objective - the goal of this research is to develop quantum mechanical computational techniques to study nonadiabatic effects in three-dimensional atom-diatom collisions. How work contributes - the results of this effort will lead to a fundamental understanding of energy exchange processes in atmospheric chemistry, combustion and lasers.

The first phase of this program will be devoted to obtaining a computationally feasible basis for representing the scattering wave function for rearrangement collisions involving ground and excited state carbon and oxygen with singlet sigma and doublet pi molecules. Then, couplings responsible for non-adiabatic transitions will be obtained, initially from diatomics-in-molecules theory.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0034, PHASE TRANSITION IN SOLID HYDROGEN ALLOYS AND OTHER DISORDERED SYSTEMS

J.R. Gaines, Ohio State University, Columbus Campus, School of Mathematics & Physical Sciences, Dept. of Physics, *164 W. 17th Ave., Columbus, Ohio* 43210 (DMR78-07527)

Experimental studies will be made of phase transitions in solid hydrogen below 0.5K. Nuclear magnetic resonance techniques will be used to study single crystals containing very low concentrations of orthohydrogen. Measurements of the heat capacity of small samples of solid hydrogen will be made above and below the transition temperature. This work is important to understanding the behavior of quantum solids.

This is a continuation of work supported under DMR76-11427. First year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0035, ADVANCED CONCEPTS IN CLOSED-CYCLE ELECTRICAL DISCHARGE LASER TECHNOLOGY

R.A. Olson, Systems Research Lab. Inc., *500 Woods Dr., Dayton, Ohio* 45432 (DF460890; F33615-76-C-2177)

AF function - electrical discharge gas lasers. Deficiency - presently there are no coherent long-life light sources to simultaneously cover all transmission windows from 1 to 5 microns. Research - an existing research system will be improved in aerodynamics, power conditioning and excitation, including photoionization to meet AF requirements. A significant decrease in size and weight will be achieved by development of a compact configuration. The closed-cycle laser technology developed will be applied to other electrical discharge lasers of AF interest. How research contributes - this research supports several AF requirements for multiple wavelength medium power high rep rate sources in the visible-to-infrared spectral range for electro-optical countermeasures.

The state-of-the-art of closed-cycle laser technology will be improved further by developing and incorporating new aerodynamic configuration concepts, by improvements in the laser geometry, by further development of the fast pulse-high repetition rate power conditioning system and by improving the laser parameter range (wavelength, power, rep-rate), for example, with improved photo-preionization. A new coaxial-flow system will be developed and tested. The closed cycle-high purity technology will be applied to other selected electrical discharge lasers of AF interest.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

8.0036, MAGNETIC IMPURITIES AND RADIATION DAMAGE IN PEROVSKITE AND RUTILE STRUCTURED MATERIALS

W.A. Sibley, Oklahoma State University, School of Arts & Sciences, Dept. of Physics, *Agricultural Hall, Stillwater, Oklahoma* 74075 (DMR77-12594)

This research was previously supported under DMR-7302349 A01. This research will involve the growth, preparation and optical characterization of previously little studied fluoride materials. In particular, studies of the optical and radiation damage of 3-D and rare-earth impurities will be made in crystals such as MgF2, MnF2, RbMgF3 and RbMnF3. From past research in this program, it has been possible to assign optical transitions, both absorption and emission, to particular energy levels for transition metal ions such as Mn ions, Co ions and Ni ions, and to study the effect of radiation-induced defects on the optical properties of these impurities. This research will attempt to understand how energy transfer occurs in these materials and whether the lifetimes of the optical transitions are reduced greatly by the presence of defects. Also, it will be determined whether in RbMnF3 and MnF2 radiation damage affects the optical oscillator strength of the Mn ions. In general this research will continue the work of understanding up-conversion and energy transfer in these materials.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0037, RELATIVISTIC CALCULATIONS OF ENERGIES, AUGER RATES AND LIFETIMES

B. Crasemann, Oregon State Higher Education System, University of Oregon, School of Liberal Arts, Dept. of Physics, *1472 Kincaid St., Eugene, Oregon* 97401 (DF054220; AFOSR-79-0026)

AF function - this research contributes to RO 6.3, electromagnetic weaponry. Deficiency - energy levels and transition rates are needed in laser design. Objective - to develop and use methods of calculation of properties of atoms. Contributions - the availability of the results of this work will make it easier to develop new kinds of lasers since an accurate guide of atomic energy levels and transition rates will exist.

Atomic transition rates and configuration interaction energies are being calculated using a relaxed-orbital relativistic Hartree-Fock-Stater method. The total wave function is assumed to be a single Slater determinant of orbital functions, each of which is a solution of the DIRAC Hamiltonian.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0038, THE STRUCTURE AND LATTICE DYNAMICS OF MONOLAYERS ON CRYSTALLINE SUBSTRATES

A.D. Novaco, Lafayette College, Undergraduate School, Dept. of Physics, *Easton, Pennsylvania* 18042 (DMR75-15630 A01)

A theoretical study will be made of the structure and lattice dynamics of monolayer films on crystalline substrates. These systems are examples of two-dimensional displacive incommensurate solids, with the incommensurate structure in the monolayer being driven by the substrate. A variety of systems will be examined, some being treated with perturbation theory and some with an extended version of the self-consistent phonon approximation.

Research previously supported by DMR75-15630.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0039, STATISTICAL MECHANICS AND THEORY OF SOLIDS

H.B. Callen, University of Pennsylvania, School of Arts & Sciences, Dept. of Physics, *34th & Spruce Sts., Philadelphia, Pennsylvania* 19104 (DMR76-21703 A02)

Research on the statistical mechanical properties of condensed matter carried out under NSF grant DMR72-03146 will be continued. Common to several aspects of this program is the use of renormalization-group techniques in phenomena other than thermodynamic phase transitions. In particular, such techniques will be used for studies of percolation, the theory of random systems, and the problem of turbulence. The latter, and the study of systems far from thermodynamic equilibrium, represents a new area of interest to be pursued during this grant period.

Further investigations using the renormalization group on the various liquid crystal phase transitions, and on phase transitions of surfaces, will be carried out.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0040, INELASTIC ELECTRON SCATTERING FROM SURFACE ADSORBATES

E.W. Plummer, University of Pennsylvania, School of Arts & Sciences, Dept. of Physics, *34th & Spruce Sts., Philadelphia, Pennsylvania* 19104 (DMR78-08520)

This is an extension of research previously supported by NSF grant DMR-7302656 A01.

Vibrational modes of atoms and molecules on solid surfaces will be studied using high resolution inelastic electron scattering. The mechanisms for the scattering of low-energy electrons from adsorbed complexes will be investigated in an attempt to observe short range molecular scattering. In this scattering mode all of the fundamental modes of the surface complexes can be observed. The identification of the fundamental vibrational modes will enable one to identify the bonding configurations of a surface atom or molecule. This information is important in understanding bonding and reactions at solid surfaces.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0041, MECHANISMS OF PORE, DISLOCATION AND PRECIPITATE NUCLEATION AND GROWTH DURING HIGH TEMPERATURE ION BOMBARDMENT

W.J. Choyke, University of Pittsburgh, School of Arts & Sciences, Dept. of Physics & Astronomy, *4200 5th Ave., Pittsburgh, Pennsylvania* 15260 (DMR78-02598)

Many metals subjected to atomic displacement damage exhibit complex microstructural changes not seen under normal thermal equilibrium conditions. In all cases the evolution of the microstructure involves competitive nucleation and growth processes which proceed by the diffusion and aggregation of point defects and impurities. While there is a large body of experimental data and theory which has been identified and examined in detail, the mechanisms of point defect diffusion and clustering at low temperatures and damage levels in many metals and alloys, the mechanisms at temperatures and atomic displacement levels of interest to the new fields of implantation metallurgy and simulation of fast neutron effects remain largely unexplored. The purpose of this program is to identify the mechanisms of diffusion and aggregation of point defects and impurities involved in the nucleation and growth of voids, dislocation loops and precipitates under ion bombardment at temperatures high enough for self-diffusion to occur. Two co-impinging beams of helium ions and silicon ions are used to simultaneously produce lattice damage and introduce an isoluble impurity. In single crystals of copper, molybdenum and polycrystalline type 304 stainless steel, ion channeling, anelastic relaxation and transmission electron microscopy measurements will be used to determine impurity site occupancy, nature of the impurity-point defect aggregates, and the kinetics of diffusion and precipitation. The mechanisms of diffusion and aggregation of point defects and impurities will be identified by reconciling the measured properties with nucleation and growth reaction rate theories. This is a continuation of research previously funded under NSF Grant DMR75-01032 A02. This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0042, RADIATION PROBLEMS IN GENERAL RELATIVITY

A.I. Janis, University of Pittsburgh, School of Arts & Sciences, Dept. of Physics & Astronomy, *4200 5th Ave., Pittsburgh, Pennsylvania* 15260 (PHY78-13926)

Theoretical physics research will be done in the area of general relativity. The following is a brief summary of the main topics to be emphasized. 1) There will be continued study of the geometric properties of the four-complex dimensional space (H-space) of asymptotically shear-free null surfaces in asymptotically flat space-times and its relationship to twistor theory. Particular points to be worked on are: a) Generalization of the techniques to include Yang-Mills theory. b) To further explore the unusual theory of equations of motion (ponderomotive force laws) that seems to be emerging. c) To understand, more precisely, how to find the physical space which produced a given H-space. d) To find more explicit H-spaces. e) To study the wide class of two-dimensional real H-spaces. f) To generalize the Penrose twistor particle classification scheme to deformed twistor space. g) To study the use of hyperfunction theory and sheaf theory in the case of non-analytic solutions to field equations. 2) It is planned to study several aspects of angular momentum in general relativity. In particular these include the removal of the ambiguities in the definition of angular momentum and the difficult question of finding the relationship between the rotational motion of sources and the total angular momentum.

This work is a continuation of that currently supported under NSF grant PHY76-17253 AO1.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0043, TRANSIENT NUCLEAR MAGNETIC RESONANCE STUDY OF SOLIDS

I.J. Lowe, University of Pittsburgh, School of Arts & Sciences, Dept. of Physics, *4200 5th Ave., Pittsburgh, Pennsylvania* 15260 (DMR78-15441)

Several solid-state physics experiments will be carried out using nuclear magnetic resonance (NMR). These include: (1) a continuation of the measurements of hydrogen diffusion in solids; (2) a continuation of line shape measurements in motionally narrowed solids such as NH4Cl and ice to better understand diffusive motion in solids; (3) a study of superionic conductors such as PbF2 to understand how the motion of the fluorine atoms is influenced by dopants. Measurements of various high pressure phases of ice will also be carried out.

This research was previously supported DMR-7622655.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0044, CHARGE TRANSFER BETWEEN HYDROGEN BEAMS AND NOBLE GASES

H.R. Dawson, Angelo State University, School of Science, Dept. of Physics, *San Angelo, Texas* 76901 (AJ-497)

Absolute cross-sections for the transfer of electrons into the 3S, 3D and 3P states of atomic hydrogen produced by proton and deuteron impact on gaseous targets of N2O and CO have been measured over the energy range between 2.2 and 8.2 keV. Over this energy range the N2O exhibits cross-section of 8 times 10 to the minus 18th power/cm for both 3D and 3S state capture. Capture into the 3P state is too small to measure by this technique. These measurements are almost the same as those made in this laboratory for a CO2 target. For the same energy range the CO target exhibits cross-sections of 4.5 times 10 to the minus 18th power/cm, 3 times 10 to the minus 18th power/cm and 11 times 10 to the minus 18th power/cm for the 3S, 3D and 3P states, respectively. These results compare in magnitude with those measured in this laboratory for O2, H2 and N2 targets.

SUPPORTED BY Robert A. Welch Foundation

8.0045, GAS-SOLID INTERACTIONS AT SEMICONDUCTOR SURFACES

J.H. Lunsford, Texas A & M University, College Station Campus, School of Science, Dept. of Chemistry, *College Station, Texas* 77843 (CHE78-09811)

This project is in the Structural Chemistry and Thermodynamics program, in the subfield of surface chemistry and heterogeneous catalysis. Reactions of the oxygen ions, O, O2, O3, with adsorbed species on various substrates, both non-catalytic and catalytic, will be studied by electron paramagnetic resonance spectroscopy (EPR). The catalytic oxidation of hydrocarbons by N2O will be investigated. It is thought that these reactions may proceed via oxygen ion intermediates. Other experiments will be devoted to the formation of O ions from lattice oxide ions, and to the generation of O ions in supported niobium. The research will progress from known oxygen species to surface reactions, and finally, the catalytic processes. The EPR technique limits the range of surfaces which may be studied, but a number of metal oxide systems are suitable; these include some supported transition metal oxides.

This research is a continuation of that currently supported by Foundation Grant, CHE-7515456.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

8.0046, AN EXPERIMENTAL STUDY OF SURFACE INTERFACES IN SOLIDS

D.G. Naugle, Texas A & M University, College Station Campus, School of Science, Dept. of Physics, *College Station, Texas* 77843 (A-514)

Measurements of the specific heat of thin foils of amorphous LaGa and LaAu alloys have been completed and provide a wealth of information. Values of the Debye temperature, electron-phonon coupling constant and the electronic density of states have been determined. Our measurements indicate that unlike most amorphous non-transition metals the electronic structure is not free electron-like and the strength of the electron-phonon interaction is intermediate. Variations in these properties with Ga or Au concentration suggest a change in the short range order at a concentration of about 24 in agreement with computer calculations based on the dense random packing model of the amorphous structure.

The specific heat of a bulk-like NiO powder with an average particle size of 1300 A and surface area of 7 sq. meters/gm land stated purity of 99.995% has been measured in the temperature range from 18K-300K. The results are in reasonably good agreement with and exhibit comiderably less scatter than the high temperature measurements of Selz, et al. At lower temperatures the measured values are appreciably higher than those calculated by Thompson, et al., from inelastic neutron scattering. Estimates indicate that the discrepancy cannot be explained by size or surface effects.

SUPPORTED BY Robert A. Welch Foundation

8.0047, ENERGY GAP STUDIES IN THIN FILM SUPERCONDUCTORS

B.J. Marshall, Texas Tech University, School of Arts & Sciences, Dept. of Physics, *P.O. Box 4340, Lubbock, Texas* 79409 (D-170)

The interaction of surface acoustic waves with conduction electrons in thin film superconductors provides a method of determining the superconducting energy gaps in these thin films. A comparison of these energy gaps with the values previously obtained for the same materials in the bulk state provides one means of understanding the transition temperature enhancement in thin film superconductors.

The ultrasonic surface acoustic waves are generated by interdigital gratings plated onto both quartz and lithium niobate substrates. Thin films ranging from 100 A up to 10,000 A for Zn, Nb and Cd are presently being investigated. The material being studied is plated onto the substrate in the region between the sending and receiving interdigital gratings. This requires the surface wave to travel through the thin film resulting in energy being removed from the surface wave due to the electron-phonon interactions. By measuring the temperature dependence of this energy loss the superconducting energy gap can be calculated.

SUPPORTED BY Robert A. Welch Foundation

8.0048, STUDIES OF WHISTLER MODE SIGNALS FROM SIPLE STATION AND RELATED GEOPHYSICAL PHENOMENA

W.R. Sheldon, University of Houston, School of Arts & Sciences, Dept. of Physics, *3801 Cullen Blvd., Houston, Texas* 77004 (DPP75-13566 A03)

This is a supplement to Grant Number DPP 7513566. Previous award number is DPP 7513566 AO2 (proposal No. DPP 7623981).

This research on very-low-frequency wave particle interactions, orginally scheduled for the austral summer of 1977/78, has been delayed one year, and a pre-Siple rocket flight to test the research payload has been scheduled for January 1978 at Andeness, Norway.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Polar Programs

8.0049, TRANSITIONS AND ELECTRONIC PROPERTIES OF NON-CRYSTALLINE MATERIALS

J.C. Thompson, University of Texas, Austin Campus, School of Arts & Sciences, Dept. of Physics, *200 W. 21st, Austin, Texas* 78712 (F-145)

Studies of optical properties of molten alloys of Ga, In or Tl with Te are being extended to higher photon energies. The optical system is being rebuilt to permit the study of chemically reactive systems at higher temperatures. Data already obtained confirm the central role of the non-bonding pi electrons from Te in the semiconducting properties. Molecular clusters such as Ga2Te3, In2Te3, Tl2Te form with Ga-Te, In-Te, Tl-Te bonds and associated sigma bands.

A new, electrodeless Hall effect apparatus has been used to confirm the existence of mobility maximum in Na-NH3 solutions near 4 mole percent metal. While this excess mobility is associated with the phase separation and metal-nonmetal transition, no mechanism has yet been found. Li, K and Cs solutions do not show the excess.

Electrons have been photo-injected into NH3 from p-type Si and GaAs electrodes. The es level has therefore to be lower with respect to the vacuum in NH3 than in H2O. This suggests that the electron may enter the e8 bands level instead.

SUPPORTED BY Robert A. Welch Foundation

8.0050, ELECTRONIC STATES AT SURFACES OF SOLIDS

L. Kleinman, University of Texas, Austin Campus, School of Natural Sciences, Dept. of Physics, *200 W. 21st St., Austin, Texas* 78712 (DMR77-21559)

Theoretical calculations of the electronic structure of transition metal surfaces will be performed. First, ab initio calculations of the energy bands of a thin film of paramagnetic iron will be carried to self-consistency. Secondly, parameterized LCAO calculations on thicker films will be done.

Also to be calculated is the photocurrent of each spin due to a single-step process involving the excitation of the electrons near the surface into time-reversed LEED states. The surface resonance in tungsten will be examined in order to settle the question of whether this experimental feature is due to a spin-orbit induced resonance or an ordinary surface state. Finally, using techniques developed for electron calculations, the phonon densities of states on stepped surfaces will be calculated.

Continuation of research supported by DMR73-02449 A02. This is the first year of a 3-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0051, PHASE TRANSFORMATIONS IN THE SOLID STATE

W.D. McCormick, University of Texas, Austin Campus, School of Natural Sciences, Dept. of Physics, *200 W. 21st St., Austin, Texas* 78712 (F-610)

We have measured, in separate experiments, the heat capacity of six single crystals of K2SnCl6, in the temperature range 250 K to 265 K. The masses of the samples varied from 9 to 147 mg. We found evidence for two structural phase transformations at 260.5 plus or minus 0.5 K and 253.5 plus or minus 1.0 K. The temperature variability indicated was from sample to sample. Both transitions were found to be first order: the upper transition having a substantial latent heat, and the lower transition being nearly second order with a very small latent heat. We were able to confirm the presence of the lower of these two phase transitions, the existence of which has been somewhat controversial, even though the total height of the heat capacity anomaly associated with it was only about 2%. This was because, with the 'microcalorimetric' heat capacity technique developed under this grant, we were able to achieve a resolution of about plus or minus 0.1%, even with these very small samples.

SUPPORTED BY Robert A. Welch Foundation

8.0052, PROPERTIES OF DILUTE MAGNETIC ALLOYS AT VERY LOW TEMPERATURES AND NUCLEAR COOLING

O.G. Symko, Utah Higher Education System, University of Utah, School of Letters & Science, Dept. of Physics, *1400 E. 2nd S., Salt Lake City, Utah* 84112 (DMR76-21702 A01)

Experimental studies of dilute magnetic impurities at very low temperatures previously supported by NSF grant DMR71-01802 will be continued. The interest is in the behavior of transition-metal impurities in a non-magnetic metal host. Such impurities will interact strongly with their surroundings, and in particular they will interact with the crystalline field produced by the surrounding ions and conduction electrons, with the conduction electrons, and with the other impurities; also, hyperfine interactions and a spin-compensated Kondo state can exist. These effects will be studied by measuring the magnetization as a function of temperature in the following alloys: Zn-Cr, Mg-Mn, Au-Mn, and Cu-Cr. As impurity-impurity interactions are quite strong, it will be necessary to go to very low impurity concentrations to observe some of the above mentioned single-impurity effects. The latter tend to be weak and hence low temperatures are necessary to reduce the thermal energy kT. A nuclear cooling apparatus together with a SQUID magnetometer will be used to study the ground-state behavior of some of the above alloys and nuclear quadrupole interactions in metals.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0053, MAGNETIC RESONANCE STUDY OF ATOMIC AND MOLECULAR MOTIONS

D.C. Ailion, Utah Higher Education System, University of Utah, School of Science, Dept. of Physics, *1400 E. 2nd S., Salt Lake City, Utah* 84112 (DMR76-18966 A01)

This research was previously supported under NSF grant DMR-7618966.

Recently developed techniques will make use of nuclear magnetic resonance (NMR) to obtain a microscopic understanding of atomic and molecular motions in solids. NMR relaxation time techniques will be applied to the study of ionic diffusion in solid electrolytes such as sodium B'-alumina. Because of the very high conductivity of sodium ions in B and B'-alumina, these substances have a variety of practical applications in problems where energy storage and conversion are important.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0054, THE RESPONSE OF THE HIGH LATITUDE IONOSPHERE TO CONVECTION ELECTRIC FIELDS

W.J. Raitt, Utah Higher Education System, Utah State University, School of Science, Dept. of Physics, *Main Bldg., Office 104, Logan, Utah* 84321 (DF582300; F19628-79-C-0025)

AF function - surveillance, communication, navigation. Deficiency - inadequate knowledge of plasma flows, charge distributions, electric fields for the design needs of AF systems. Objective - study high latitude ionospheric dynamics in three areas - 1. High latitude f region dynamics. 2. Convection electrodynamics. 3. Polar cap plasma chemistry and dynamics. How research contributes - provides data essential to HF and UHF propagation predictions, provides data required for the design and utilization of communication guidance and surveillance systems and provides understanding of the dynamical processes in the ionosphere.

Develop theoretical procedures and computer codes to determine plasma flow, particle distributions and effects of electric fields on the high latitude ionosphere. Satellite data will be utilized to test the theoretical methods and to develop a prediction capability for the high latitude ionosphere.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

8.0055, INELASTIC ELECTRON AND SOFT X-RAY SPECTROSCOPY

S.E. Schnatterly, University of Virginia, School of Engineering & Applied Science, Dept. of Physics, *Garrett Hall, Charlottesville, Virginia* 22903 (DMR78-16753)

Experimental studies of the electronic structure and excitations in solids which previously were supported by NSF grant DMR-7721709 will be continued. Two research areas will be addressed. The first area is concerned with electron energy loss phenomena in solids. The inelastic electron scattering spectrometer previously built with NSF support will be reassembled with improvements in design at the University of Virginia. Experimental studies of X-ray thresholds, absorption edge fine structure, atomic plasmons and core excitons will be carried out using this technique. An improved understanding of these effects will provide a basis for testing the validity of current theories for single particle and collective excitations in solids. The second area of research is concerned with soft X-ray spectroscopy. An emission spectrometer is being designed and constructed which should have a significant increase in sensitivity over equipment currently available. Experiments using this technique will be carried out to complement the electron scattering experiments. Also, the application of this technique to experimental studies of surface phenomena will be investigated.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0056, STUDY OF PULSE-EXCITED NITROGEN

C.C. Lin, University of Wisconsin, Madison Campus, School of Letters & Science, Dept. of Physics, *500 Lincoln Dr., Madison, Wisconsin* 53706 (DF580220; F19628-78-C-0042)

AF function - infrared optical detection system. Deficiency - lack of knowledge of the optical and infrared emission induced by the detonation of a high altitude nuclear weapon. Objective - to investigate time-dependent radiation intensity of excited N2 at various wave lengths. How research contributes - a complete understanding of how the excited states of nitrogen are populated and their subsequent decay will contribute to the accuracy of prediction of radiation intensity from ultraviolet to infrared frequencies.

Use double laser-pulsed excitation technique to examine the first positive band of nitrogen and other bands.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

8.0057, SURFACE STRUCTURES, LATTICE DYNAMICS AND ADATOM INTERACTIONS

M.B. Webb, University of Wisconsin, Madison Campus, School of Letters & Science, Dept. of Physics, *500 Lincoln Dr., Madison, Wisconsin* 53706 (DMR78-16650)

Research on the atomic arrangements, thermal vibrations, thermodynamics and kinetic properties of surfaces and adsorbed atoms, previously supported by NSF grant No. DMR76-21576, will be continued. Experiments using the low energy electron diffraction technique will be performed on Si (100) and (111) surfaces, both clean and with adsorbed gases, and Ag (111) surfaces with adsorbed Xe and other noble gases. The information obtained will contribute significantly to the understanding of the electronic and chemical processes of semiconductor surfaces, and of the interactions of adsorbed gas atoms with the substrate surface and with each other.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, MICROMETRIC MEASURES OF VISUAL DOUBLE STARS

F. Holden, (No Performing Organization Reported), *California* (AST77-00249 A01)

Support for an additional year will allow continuation of measures, with bifilar micrometers, of visual double stars in California, Chile, and Venezuela. The 36-inch refractor of Lick Observatory will be again available and, in the northern winter when California does not have its best seeing, measures will be made in Chile and Venezuela. The southern observatories of Cerro Tololo and Las Campanas will be visited and also the C.I.D.A. Observatory near Merida, Venezuela, to extend the observations through both hemispheres of the sky.

Double stars are important because they are more numerous than single stars in our galaxy and from their orbital motions information about stellar masses is obtained.

Previous support was by NSF grant AST 77-00249.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

10.0002, AIRBORNE OBSERVATIONS OF PASCHEN ALPHA EMISSION IN SEYFERT GALAXIES

B.T. Soifer, California Inst. of Technology, Graduate School, Dept. of Physics Mathematics & Astronomy, *1201 E. California Blvd., Pasadena, California* 91109 (NSG 2413)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

10.0003, DETECTION, SPECTROSCOPY AND PHYSICAL STUDY OF RADIO GALAXIES AT LARGE RED SHIFTS

H. Spinrad, University of California, Berkeley Campus, School of Letters & Science, Dept. of Astronomy, *Berkeley, California* 94720 (AST77-26897)

The main research objective is to study the evolution of galaxies at large red shifts (and long look-back times), and to constrain current cosmological models by means of optical observations of distant radio and cluster galaxies. The procedures require detection of limiting (V greater than or equal to 23) galaxies (radio sources or cluster members), followed up by (presently) lengthy and difficult spectrophotometry. This research then yields a red shift and color-evolution data. In a few cases, galaxy surface-brightnesses and isophotal diameters will be measured; such data will be utilized for an evaluation of galaxian luminosity evolution, if qo (the deceleration parameter) can be independently fixed. Finally the probable content of a sample of faint field galaxies will be discussed.

This is a continuation of research done under grant AST 72-05061 A04.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

10.0004, MEASUREMENT OF ATMOSPHERIC CONSTITUENT PROFILES USING THE SOLAR SPECTRUM AND THE ATMOSPHERIC EMISSION SPECTRUM IN THE INFRARED

D.G. Murcray, University of Denver, School of Arts & Sciences, Dept. of Physics & Astronomy, *2115 S. University Blvd., Denver, Colorado* 80210 (ATM77-27633)

One of the major problems of the chemistry of the stratospheric ozone layer is the lack of data on the altitude distribution of many chemical species of interest. A significant number of molecules predicted to be present in the stratosphere and to play key roles in ozone chemistry have not been directly detected at all. Many such molecules have infrared absorption bands. The objective of this research is to detect and to determine altitude distributions of trace chemical species in the stratosphere in a series of balloon-borne experiments that utilize infrared absorption and emission as the basis for detection.

Two different types of instruments will be flown under this program: (1) a solar tracking system coupled to an infrared in-

terferometer to obtain solar absorption spectra at a resolution of 0.01/cm as a function of altitude and from float altitude at sunset, and (2) an ultrasensitive spectrometer system to measure radiation emitted by the atmosphere at various altitudes up to the balloon float altitude. Absorption studies offer superior spectral resolution for sensitive and accurate identification of the molecules present in the atmosphere. Emission experiments offer increased dynamic range and the ability to detect atmospheric species at any time of day and thereby measure important diurnal variation.

Previous balloon-borne infrared experiments have been highly successful in detecting many important stratospheric species for the first time. The substantially improved infrared absorption instrumentation to be flown under this grant shows considerable promise of achieving detection and measurement of several key species for which only upper limits on concentrations have been determined previously, thereby achieving a major improvement in chemical understanding of the stratosphere. The emission experiment should achieve significant results on the concentrations of important species, such as N2O5, that are believed to reach maximum concentration at night.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Atmospheric Sciences

10.0005, OBSERVATIONAL STUDIES OF MASS EXCHANGE BETWEEN STARS AND DIFFUSE MATTER IN GALAXIES AND ACTIVE BINARY SYSTEMS

J.S. Gallagher, University of Illinois, Urbana Champaign Campus, School of Arts & Sciences, Dept. of Astronomy, *Urbana, Illinois* 61801 (AST77-18270)

Observational studies concerning interrelationships between stars and diffuse matter is presented. The research will primarily be divided between two major areas: 1. Cataclysmic Variable Stars. An emphasis will be placed on classical novae and on variable stars which share physical characteristics with novae. Specific problems will include evolution of the ejecta, abundances, and mass exchange in active binaries. 2. Optical structural characteristics of E, SO, and IO galaxies. Detailed information on internal structure and dynamics as well as the distribution of stellar populations will be needed for representative sample galaxies in order to properly assess variable atom hydrogen (HI) content in early-type galaxies. A program of optical spectrophotometry and direct broad-band and image intensifier H alpha photography has been chosen for the initial stages of this work.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Astronomical Sciences

10.0006, IONIZATION MODELS OF HIGH EXCITATION PLANETARY NEBULAE

J.P. Harrington, University of Maryland, College Park Campus, School of Engineering, Dept. of Physics & Astronomy, *College Park, Maryland* 20742 (AST78-07490)

This research will involve the construction of detailed ionization models of high-excitation planetary nebulae, with particular emphasis upon the interpretation of satellite ultraviolet observations. The purpose of this work will be to obtain estimates of the abundances of carbon, nitrogen and oxygen in these objects. This is important to our understanding of the carbon-nitrogen-oxygen cycle and helium-burning nucleosynthesis taking place in stars which become planetary nebulae.

In addition to the requirement of high-quality visual data, the nebulae chosen for modelling will be selected among those scheduled for early observation by the International Ultraviolet Explorer spacecraft. The modelling approach to be adopted is the only good method available for the analysis of the ultraviolet lines of carbon and other elements.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Astronomical Sciences

10.0007, IONOSPHERIC VARIABILITY

M.J. Mendillo, Boston University, School of Liberal Arts, Dept. of Astronomy, *755 Commonwealth Ave., Boston, Massachusetts* 02215 (DF249900; F19628-77-C-0270)

AF function - radio frequency ranging systems for navigation and satellite detection and tracking. Deficiency - monthly average models are available for correcting for the effects of the earth's ionosphere on the velocity of radio waves. However, on a day-to-day basis, the models have errors of up to 25 percent rms. The effect on the ionosphere of large magnetic storms has been studied, and can be corrected for to first order. Other variations occur which are not yet understood yet cause large errors from average conditions. Objective - study the day-to-day variability of the ionospheric f region to develop algorithms to improve models of ionospheric time delay. How research contributes -results will improve existing models of the time delay to operational radar and navigation systems, and will require the use of fewer monitoring stations to update ionospheric conditions.

The ionosphere has an approximate 25 percent variability from monthly average conditions. The contractual approach to study this variability will be to find relationships with other geophysical parameters which correlate with ionospheric parameters such as total electron content and NMAX after the effects of magnetic storms have been carefully removed from the data. Also, power spectral analyses will be done to determine the predominant spectral features of the temporal behavior and its repeatability. Some model studies will be undertaken to determine the effects of changes in neutral winds, electric fields and auroral heating on the day-to-day variability of the f region.

SUPPORTED BY U.S. Dept. of Defense, Air Force,
Geophysics Lab.

10.0008, BLACK HOLES, GRAVITATIONAL COLLAPSE OF DENSE STELLAR SYSTEMS, COSMOLOGY

A.P. Lightman, Harvard University, Cambridge Campus, School of Arts & Sciences, Dept. of Astronomy, *Cambridge Station, Cambridge, Massachusetts* 02138 (AST78-08428)

The research to be carried out under this grant involves studies of cosmology, the gravitational collapse of dense stellar systems, and the interactions of black holes with their environments. Specific problems to be considered include: massive black holes in globular clusters and galactic nuclei, detailed time-dependent analysis of energy conduction processes and rates in two-species gravitating systems, the nature of the active nucleus of the Seyfert galaxy NGC 4151, the possibility of dissolution of globular clusters, and relaxation effects in cosmological mass condensations.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Astronomical Sciences

10.0009, STUDIES IN THE MATHEMATICAL THEORY OF GLOBAL CLIMATE

G.R. North, University of Missouri, St. Louis Campus, School of Arts & Sciences, Dept. of Physics, *8001 Natural Bridge Rd., St. Louis, Missouri* 63121 (ATM78-07962)

This project is a two-year continuation of the analytical study of simple climate models. Certain features of these models have been established such as multiple branch solutions, stability theory and estimates of sensitivity under specific assumptions. Further work needs to be done to provide a guide or reference line for larger model studies. Proposed work includes: the extension of a stationary perturbation theory which predicts the change in large-scale climate due to infinitesimal external changes (such as CO2 concentration); the extension of a variational principle to larger classes of models; the extension of a simple seasonal model to include climate change with ice feedback; the study of fluctuations in model solutions due to various stochastic inputs; and the extension of the simple terrestrial models to the example of the planet Mars.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Atmospheric Sciences

10.0010, ULTRAVIOLET AND X-RAY BOMBARDMENT OF PLANETARY ATMOSPHERES

J.A. Samson, University of Nebraska, Lincoln Campus, School of Arts & Sciences, Dept. of Physics & Astronomy, *Lincoln, Nebraska* 68508 (ATM78-05702)

The interaction of solar radiation with a planet's atmosphere depends critically upon the wavelength of the incident radiation. The energetic radiation below 2000 A causes dissociation, ionization, and dissociative ionization of atmospheric molecules. The resulting molecular fragments react with ambient species to form a source of new molecules in the atmosphere, while the ionic fragments are the starting species in ionospheric chemistry. The objective of this research is to investigate the interaction of solar ultraviolet radiation with planetary atmospheres and to provide cross-sections for specific interactions as functions of wavelength in the interval 100-1400 A. The techniques used in the study include measurement of kinetic energies of ejected photoelectrons (photoelectron spectroscopy) and of ionic species with a mass spectrometer.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Atmospheric Sciences

10.0011, COSMIC RAY ANISOTROPY, SOLAR MAGNETISM AND HELIOMAGNETOSPHERE

H.S. Ahluwalia, University of New Mexico, School of Arts & Sciences, Dept. of Physics & Astronomy, *University Hill N.E., Albuquerque, New Mexico* 87106 (ATM78-10727)

This award will support an attempt to understand the observed day-to-day and the long-term changes in the parameters of the diurnal, the semidiurnal and the tridiurnal components of the solar daily variation of cosmic rays, in an attempt to arrive at a unified theory of the anisotropies of solar origin which contribute to these ordered interplanetary magnetic fields, far away from the plane of the ecliptic. This study might make it possible to draw certain inferences regarding the broad scale ordering of the interplanetary magnetic field and the time variations in it, over a solar cycle. One can compare these inferences with the predictions of theoretical models.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Atmospheric Sciences

10.0012, MOLECULAR SPECTROSCOPY FROM THE KUIPER AIRBORNE OBSERVATORY

S. Beckwith, Cornell University, Ithaca Campus, Graduate School, *101 Sage Graduate Ctr., Ithaca, New York* 14850 (NSG 2412)

SUPPORTED BY U.S. National Aeronautics & Space Admin.,
Ames Research Center

10.0013, THEORY OF GRAVITATION

J.W. York, University of North Carolina, Chapel Hill Campus, School of Arts & Sciences, Dept. of Physics & Astronomy, *Chapel Hill, North Carolina* 27514 (PHY76-83252)

Research initiated under NSF grant PHY74-14191 AO4 will be continued. This project deals primarily with the dynamics of gravitational fields according to the general theory of relativity. The principal feature of the analysis is that it is based on the conclusions that have been reached from a comprehensive analysis, using conformal methods, of the initial-value equations, which form the foundation of the dynamical structure. In particular, the following topics will be investigated: 1. The space of degrees of freedom of asymptotically flat gravitational fields. 2. The natural kinematical gauge conditions that are suggested by the conformal analysis of the initial-value problem. The 'minimal coordinate shear' condition is of particular interest in regard to the evolution of Cauchy data, and the explicit characterization of gravity waves on space-like slices. 3. Incorporation of the constraint equations and the above gauge conditions into the Hamiltonian form of classical general relativity. 4. Implications of the above results for a quantum theory of gravity. 5. Continuation of work on numerical construction of initial data for calculation of astrophysical interest.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical
Sciences, Div. of Physics

10.0014, CONSTRUCTION AND INSTALLATION OF A REMOTELY CONTROLLED CASSEGRAIN SPECTROGRAPH SYSTEM FOR THE MCDONALD OBSERVATORY 2.7-METER TELESCOPE

H.J. Smith, University of Texas, Austin Campus, School of Natural Sciences, Dept. of Astronomy, *200 W. 21st St., Austin, Texas* 78712 (AST76-23326)

A Cassegrain spectrograph system will be constructed and installed at the 2.7-meter (107-inch) telescope of the McDonald Observatory of the University of Texas. The design of this system will be modelled on the automated Miller spectrograph at the Lick Observatory of the University of California. The system will consist of four major parts: (1) the telescope utility bench, which will support the spectrograph, detector calibration lamps and the television guiding system; (2) the Cassegrain spectrograph; (3) the detector system, and (4) the read-out and data handling system.

Actual construction of most of the parts of the system will be carried out at the McDonald Observatory Shop, located at the Bee Caves Research Center and Observatory. Construction should take approximately one year. Installation and operation will begin in the second year.

Scientific projects that will make use of the new spectrograph will cover many areas of astrophysics: radio galaxies, galaxies in clusters, quasi-stellar objects, time-resolved spectroscopy of rapidly varying stellar sources such as cataclysmic binaries, variable white dwarf stars, dwarf cepheids, and flare stars.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Astronomical Sciences

10.0015, A STUDY OF STRATOSPHERIC AEROSOL SOURCES, FORMATION PROCESSES AND ROLE AS A SINK FOR TRACE GASES

D.J. Hofmann, University of Wyoming, School of Arts & Sciences, Dept. of Physics & Astronomy, *P.O. Box 3435, University Station, Laramie, Wyoming* 82070 (ATM77-27552)

This action funds the study of the nature and importance of the stratospheric sulfate aerosol layer in terms of defining the source, investigating aerosol formation processes and investigating the importance of transport processes. These research goals will be sought by conducting stratospheric balloon soundings of ozone, r greater than or equal to 0.15 micron, aerosol r greater than or equal to 0.01 micron condensation nuclei and by observing the vaporization point of the volatile aerosol in the sulfate layer over Laramie, Wyoming. Major emphasis will be placed on continuing monthly aerosol soundings at Laramie as have been done in the past year, to attempt to sort out volcanic and transport effects. In studying transport phenomena, ozone measurements are important as another tracer of equatorial air. Laboratory studies of ozone sensors will continue in hopes that a chemiluminescent detector can be suitably calibrated prior to balloon launch so the absolute as well as relative ozone data can be obtained. Continued research on the condensation nuclei counter is necessary to improve its high-altitude response. Some of this work should be done this summer along with additional aerosol vaporization measurements. To increase the versatility of balloon platforms for stratospheric research, work will proceed on developing small multi-balloon systems wherein the number of balloons is varied to obtain different float altitudes and developing radio command capabilities so that the experimenter can control his experiment from the ground. Related work funded by the Office of Naval Research and the Army Research Office will be coordinated with this effort.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Atmospheric Sciences

VOLUME 18 NUMBER 15/AUGUST 8, 1980

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N80-24259* National Aeronautics and Space Administration, Washington, D. C.
AERONAUTICAL ENGINEERING. A CONTINUING BIBLIOGRAPHY WITH INDEXES. SUPPLEMENT 121, APRIL 1980
Apr. 1980 128 p
(NASA-SP-7037(121)) Avail: NTIS HC $5.00 CSCL 01A

This bibliography lists 411 reports, articles, and other documents introduced into the NASA Scientific and Technical Information system in March 1980. Author

N80-24260*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
DEVELOPMENT OF TEST METHODS FOR SCALE MODEL SIMULATION OF AERIAL APPLICATIONS IN THE NASA LANGLEY VORTEX RESEARCH FACILITY
Frank L. Jordan, Jr. Apr. 1980 17 p refs Presented at the AIAA 11th Aerodyn. Testing Conf., Colorado Springs, Colo., 18-20 Mar. 1980
(NASA-TM-81805) Avail: NTIS HC A02/MF A01 CSCL 01B

As part of basic research to improve aerial applications technology, methods were developed at the Langley Vortex Research Facility to simulate and measure deposition patterns of aerially-applied sprays and granular materials by means of tests with small-scale models of agricultural aircraft and dynamically-scaled test particles. Interactions between the aircraft wake and the dispersed particles are being studied with the objective of modifying wake characteristics and dispersal techniques to increase swath width, improve deposition pattern uniformity, and minimize drift. The particle scaling analysis, test methods for particle dispersal from the model aircraft, visualization of particle trajectories, and measurement and computer analysis of test deposition patterns are described. An experimental validation of the scaling analysis and test results that indicate improved control of chemical drift by use of winglets are presented to demonstrate test methods. A.R.H.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*.

N80-24261*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
THEORY FOR COMPUTING THE SIZE AND SHAPE OF A REGION OF INFLUENCE ASSOCIATED WITH A MANEUVERING VEHICLE
Raymond L. Barger May 1980 22 p refs
(NASA-TP-1648; L-13419) Avail: NTIS HC A02/MF A01 CSCL 01A

A general procedure for computing the region of influence of a maneuvering vehicle is described. Basic differential geometric relations, including the use of a general trajectory parameter and the introduction of auxiliary variables in the envelope theory are presented. To illustrate the application of the method, the destruct region for a maneuvering fighter firing missiles is computed. Author

N80-24262*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
COMPARISON OF CALCULATED AND MEASURED MODEL ROTOR LOADING AND WAKE GEOMETRY
Wayne Johnson Apr. 1980 34 p refs Prepared in cooperation with Army Research and Technology Labs., Moffett Field, Calif.
(NASA-TM-81189; AVRADCOM-TR-80-A-4; A-8149) Avail: NTIS HC A03/MF A01 CSCL 01A

The calculated blade bound circulation and wake geometry are compared with measured results for a model helicopter rotor in hover and forward flight. Hover results are presented for rectangular tip and ogee tip planform blades. The correlation is quite good when the measured wake geometry characteristics are used in the analysis. Available prescribed wake geometry models are found to give fair predictions of the loading, but they do not produce a reasonable prediction of the induced power. Forward flight results are presented for twisted and untwisted blades. Fair correlation between measurements and calculations is found for the bound circulation distribution on the advancing side. The tip vortex geometry in the vicinity of the advancing blade in forward flight was predicted well by the free wake calculation used, although the wake geometry did not have a significant influence on the calculated loading and performance for the cases considered. Author

N80-24263*# General Dynamics/Fort Worth, Tex.
EXPERIMENTAL INVESTIGATION OF A 0.15 SCALE MODEL OF A CONFORMAL VARIABLE-RAMP INLET FOR THE F-16 AIRPLANE Final Report
J. E. Hawkins Mar. 1980 219 p refs Sponsored by NASA
(NASA-CR-159640; ERR-FW-2014) Avail: NTIS HC A10/MF A01 CSCL 01A

A 0.15 scale model of a proposed conformal variable-ramp inlet for the Multirole Fighter was tested from Mach 0.8 to 2.2 at a wide range of angles of attack and sideslip. Inlet ramp angle was varied to optimize ramp angle as a function of engine airflow, Mach number, angle of attack, and angle of sideslip. Several inlet configuration options were investigated to study their effects on inlet operation and to establish the final flight configuration. These variations were cowl sidewall cutback, cowl lip bluntness, boundary layer bleed, and first-ramp leading edge shape. Diagnostic and engine face instrumentation were used to evaluate inlet operation at various inlet stations and at the inlet/engine interface. Pressure recovery and stability of the inlet were satisfactory for the proposed application. On the basis of an engine stability audit of the worst-case instantaneous distortion patterns, no inlet/engine compatibility problems are expected for normal operations. Author

N80-24264*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
EFFECTS OF FREE-STREAM TURBULENCE ON DIFFUSER PERFORMANCE
Jon A. Hoffmann Jun. 1980 51 p refs
(Grant NsG-2391)
(NASA-CR-163194) Avail: NTIS HC A04/MF A01 CSCL 01A

An experimental evaluation of the effects of free stream turbulence on the performance of a subsonic two dimensional diffuser was made. The diffuser's static pressure recovery coefficient was increased 11.4 and 21.1 percent at total. Divergence angles of 12 and 20 degrees respectively were obtained when the value of the inlet integral free stream scale of turbulence in the flow direction was at least 7.5 times larger than the inlet boundary layer displacement thickness, and when the inlet total free stream turbulence intensity was at least 3.5 percent. It is hypothesized that a larger scale of turbulence transmits the free stream energy to the wall more effectively and when coupled with large turbulence intensities, acts to decrease the distortion and delay separation within the diffuser. J.M.S.

N80-24265*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INSTRUMENTATION FOR CALIBRATION AND CONTROL OF A CONTINUOUS-FLOW CRYOGENIC TUNNEL
Charles L. Ladson and Robert A. Kilgore May 1980 13 p refs Presented at AGARD-VKI Lecture Ser. 3 on Cryogenic Wind Tunnels, May 1980
(NASA-TM-81825) Avail: NTIS HC A02/MF A01 CSCL 01A

Those aspects of selection and application of calibration and control instrumentation that are influenced by the extremes in the temperature environment to be found in cryogenic tunnels are described with emphasis on the instrumentation and data acquisition system used in the Langley 0.3 m transonic cryogenic tunnel. Typical calibration results obtained in a 20 by 60 cm two dimensional test section are included. A.R.H.

N80-24266*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF CONVENTIONAL AND SQUARE STORES ON THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A FIGHTER AIRCRAFT MODEL AT SUPERSONIC SPEEDS
William J. Monta Jun. 1980 59 p refs
(NASA-TM-81791; L-13402) Avail: NTIS HC A04/MF A01 CSCL 01A

The effects of conventional and square stores on the longitudinal aerodynamic characteristics of a fighter aircraft configuration at Mach numbers of 1.6, 1.8, and 2.0 was investigated. Five conventional store configurations and six arrangements of a square store configuration were studied. All configurations of the stores produced small, positive increments in the pitching moment throughout the angle-of-attack range, but the configuration with area ruled wing tanks also had a slight decrease on stability at the higher angles of attack. There were some small changes in lift coefficient because of the addition of the stores, causing the drag increment to vary with the lift coefficient. As a result, there were corresponding changes in the increments of the maximum lift drag ratios. The store drag coefficient based on the cross sectional area of the stores ranged from a maximum of 1.1 for the configuration with three Maverick missiles to a minimum of about .040 for the two MK-84 bombs and the arrangements with four square stores touching or two square stores in tandem. Square stores located side by side yielded about 0.50 in the aft position compared to 0.74 in the forward position. R.E.S.

N80-24267*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF AXISYMMETRIC AND NONAXISYMMETRIC NOZZLES INSTALLED ON A 0.10 SCALE F-18 PROTOTYPE AIRPLANE MODEL
Francis J. Capone and Bobby L. Berrier Jun. 1980 304 p refs
(NASA-TP-1638; L-13401) Avail: NTIS HC A14/MF A01 CSCL 01A

The Langley 16 foot transonic tunnel was used to investigate the afterbody/nozzle longitudinal aerodynamic characteristics of three different two dimensional nozzles and a base-line axisymmetric nozzle installed on a 0.10 scale model of the F-18 airplane. The effects of thrust vectoring and in-flight thrust reversing were also stacied. Horizontal-tail deflections of 0 deg, -2 deg, and -5 deg were tested. Test data were obtained at static conditions and at Mach numbers from 0.60 to 1.20 over an angle-of-attack range from -2 deg to 10 deg. Nozzle pressure ratio was varied from jet off to about 10. A.R.H.

N80-24268*# Boeing Commercial Airplane Co., Seattle, Wash.
A GENERAL PANEL METHOD FOR THE ANALYSIS AND DESIGN OF ARBITRARY CONFIGURATIONS IN INCOMPRESSIBLE FLOWS Final Report
Forrester T. Johnson Washington NASA May 1980 200 p refs
(Contract NAS2-7729)
(NASA-CR-3079; D6-43808) Avail: NTIS HC A09/MF A01 CSCL 01A

A method for solving the linear integral equations of incompressible potential flow in three dimensions is presented. Both analysis (Neumann) and design (Dirichlet) boundary conditions are treated in a unified approach to the general flow problem. The method is an influence coefficient scheme which employs source and doublet panels as boundary surfaces. Curved panels possessing singularity strengths, which vary as polynomials are used, and all influence coefficients are derived in closed form. These and other features combine to produce an efficient scheme which is not only versatile but eminently suited to the practical realities of a user-oriented environment. A wide variety of numerical results demonstrating the method is presented. Author

N80-24269*# Beam Engineering, Inc., Sunnyvale, Calif.
SIMPLE TURBULENCE MODELS AND THEIR APPLICATION TO BOUNDARY LAYER SEPARATION Final Report
Alan J. Wadcock Washington NASA May 1980 71 p refs
(Contract NAS2-10093)
(NASA-CR-3283) Avail: NTIS HC A04/MF A01 CSCL 01A

Measurements in the boundary layer and wake of a stalled airfoil are presented in two coordinate systems, one aligned with the airfoil chord, the other being conventional boundary layer coordinates. The NACA 4412 airfoil is studied at a single angle of attack corresponding to maximum lift, the Reynolds number based on chord being 1.5 x 10 to the 6th power. Turbulent boundary layer separation occurred at the 85 percent chord position. The two-dimensionality of the flow was documented and the momentum integral equation studied to illustrate the importance of turbulence contributions as separation is approached. The assumptions of simple eddy-viscosity and mixing-length turbulence models are checked directly against experiment. Curvature effects are found to be important as separation is approached. Author

N80-24270*# Computer Sciences Corp., Hampton, Va.
THE INCORPORATION OF PLOTTING CAPABILITY INTO THE UNIFIED SUBSONIC SUPERSONIC AERODYNAMIC ANALYSIS PROGRAM, VERSION B Progress Report, 1973 - 1980
Octavio A. Winter Washington NASA May 1980 141 p refs
(Contract NAS1-14900)
(NASA-CR-3228) Avail: NTIS HC A07/MF A01 CSCL 01A

The B01 version of the United Subsonic Supersonic Aerodynamic Analysis program is the result of numerous modifications and additions made to the B00 version. These modifications and additions affect the program input, its computational options, the code readability, and the overlay structure. The following are described: (1) the revised input; (2) the plotting overlay programs which were also modified, and their associated subroutines; (3) the auxiliary files used by the program, the revised output data; and (4) the program overlay structure. R.E.S.

N80-24271*# Boeing Commercial Airplane Co., Seattle, Wash.
FURTHER INVESTIGATION OF A FINITE DIFFERENCE PROCEDURE FOR ANALYZING THE TRANSONIC FLOW

ABOUT HARMONICALLY OSCILLATING AIRFOILS AND WINGS Final Report

W. H. Weatherill, F. E. Ehlers, E. Yip, and J. D. Sebastian Washington NASA May 1980 83 p refs
(Contract NAS1-15128)
(NASA-CR-3195; D-48851) Avail: NTIS HC A05/MF A01 CSCL 01A

Analytical and empirical studies of a finite difference method for the solution of the transonic flow about harmonically oscillating wings and airfoils are presented. The procedure is based on separating the velocity potential into steady and unsteady parts and linearizing the resulting unsteady equations for small disturbances. The steady velocity potential is obtained first from the well-known nonlinear equation for steady transonic flow. The unsteady velocity potential is then obtained from a linear differential equation in complex form with spatially varying coefficients. Since sinusoidal motion is assumed, the unsteady equation is independent of time. An out-of-core direct solution procedure was developed and applied to two-dimensional sections. Results are presented for a section of vanishing thickness in subsonic flow and an NACA 64A006 airfoil in supersonic flow. Good correlation is obtained in the first case at values of Mach number and reduced frequency of direct interest in flutter analyses. Reasonable results are obtained in the second case. Comparisons of two-dimensional finite difference solutions with exact analytic solutions indicate that the accuracy of the difference solution is dependent on the boundary conditions used on the outer boundaries. Homogeneous boundary conditions on the mesh edges that yield complex eigenvalues give the most accurate finite difference solutions. The plane outgoing wave boundary conditions meet these requirements. Author

N80-24272*# Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

COHERENT SUBSTRUCTURE OF TURBULENCE NEAR THE STAGNATION ZONE OF A BLUFF BODY

Willy Z. Sadeh and Herbert J. Brauer 1980 13 p refs Presented at the 4th Colloq. on Ind. Aerodyn., Aachen, West Germany, 18-20 Jun. 1980
(Grant NsG-3127)
(NASA-CR-163191) Avail: NTIS HC A02/MF A01 CSCL 01A

The evolution of freestream turbulence in crossflow about a circular cylinder was studied in order to indentify the existence of a coherent substructure which is the outcome of the amplification of freestream turbulence by the stretching mechanism in diverging flow about a bluff body. Visualization of the flow events revealed the selective stretching of cross-vortex tubes and the emergence of an organized turbulent flow pattern near the cylinder stagnation zone. Significant amplification of the total turbulent energy of the streamwise fluctuating velocity was consistently monitored. Realization of selective amplification at scales larger than the neutral scale of the stagnation flow was indicated by the variation of the discrete streamwise turbulent energy. A most amplified scale, characteristic of the energy containing eddies within the coherent substracture and commensurate with the boundary-layer thickness, was detected. Penetration of the amplified turbulence into the cylinder boundary layer led to the retardation of separation and to a concurrent decrease in the drag coefficient at subcritical cylinder-diameter Reynolds numbers. A.R.H.

N80-24273*# Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

A DRY-SURFACE COATING METHOD FOR VISUALIZATION OF SEPARATION

W. Z. Sadeh, H. J. Brauer, and J. R. Durgin 1980 6 p refs Presented at the Intern. Symp. on Flow Visualization, Bochum, West Germany, 9-12 Sep. 1980
(Grant NsG-3127)
(NASA-CR-163192) Avail: NTIS HC A02/MF A01 CSCL 01A

A relatively simple and reasonably accurate dry-surface coating method for visualization of the separation line on a bluff body was devised and successfully tested. This technique is based on the color reaction of a dry film containing a pH indicator with an appropriate gas released in the body wake. The dry-surface coating method is effective at any Reynolds number and for both incident laminar and turbulent flows. It further supplies a colorful permanent of consistently good photographic quality of the separation line. The effectiveness and accuracy of this technique were tested in visualizing the separation angle on a circular cylinder in both laminar and turbulent crossflows at subcritical Reynolds numbers. Separation angles revealed by the visualization were within + or - 4 percent of their counterparts deduced from the mean wall pressure distribution. Author

N80-24274# Raytheon Co., Bedford, Mass. Missile Systems Div.

GUIDANCE SUBSYSTEMS WITH POSITION MEASUREMENT FOR GLIDING AIRDROP SYSTEMS Final Report, 13 Jan. - 25 Aug. 1978

C. F. Olenberger Natick, Mass. Army Natick Res. and Develop. Command Aug. 1978 173 p refs
(Contract DAAK60-78-C-0022; DA Proj. 1L1-62210-D-283)
(AD-A080730; BR-10606; NATICK/TR-79/016) Avail: NTIS HC A08/MF A01 CSCL 01/3

The objective of this work has been to assess guidance techniques and available hardware which are suitable for gliding airdrop systems. Information presented indicates the suitability of available hardware for measuring required flight data, processing these data according to one of several alternative guidance schemes and activating control lines as required to guide a gliding airdrop system. GRA

N80-24275# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

A DIAGNOSTIC STUDY OF FLOW IN THE WAKE OF A CIRCULAR DISK USING A PHOTON CORRELATION LASER VELOCIMETER M.S. Thesis

Steven L. Morris Mar. 1980 200 p refs
(AD-A082167; AFIT/GAE/AA/79D-12) Avail: NTIS HC A09/MF A01 CSCL 20/5

The present investigation involves a diagnostic study of flow in the wake of a circular disk utilizing schlieren photography and a photon correlation laser velocimeter system (LDV). The schlieren system was used to examine the basic flow pattern over a 2.0 inch diameter disk and to establish the bounds of the recirculation zone. In all tests, the flow originated from a 1.5 inch diameter axially symmetric free jet with an exit Mach number of 0.35. The disk was positioned in the flow 12 jet diameters downstream of the exit. Mean velocity and turbulence intensity profiles were measured at selected locations in the near wake region of the 2.0 and a 1.5 inch diameter disk with the LDV system. This was accomplished without particle seeding of the flow. A free jet survey was conducted for comparison with theoretical predictions to analyze the quality of the LDV data. The schlieren system produced high quality photographs from which the dimensions of the recirculation zone were obtained. Mean velocity and turbulence intensity profiles were acquired at the varied stream-wise locations behind each disk with the LDV system. The laser velocimeter system, when used in conjunction with a phase modulator, clearly indentified the flow direction. Bounds of the recirculation zone found from the LDV study agreed with the results of the schlieren study. GRA

N80-24276# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.

CAPTURE OF AN AXISYMMETRIC FREE JET IN A PIPE WITH APPLICATION TO POWER-AUGMENTED-RAM WING THEORY

Harvey R. Chaplin, Earl F. McCabe, Jr., Harry A. Berman, and William J. H. Smithey Dec. 1979 18 p refs
(ZF43411210)
(AD-A082241; DTNSRDC/ASED-79/12) Avail: NTIS HC A02/MF A01 CSCL 20/4

A theory of the two dimensional power augmented ram wing with turbulent jets was previously validated over a range of experimental conditions which did not include very small ratios of jet nozzle area to capture area. In the present investigation a simple axisymmetric experiment was conducted to evaluate this condition. Results indicate that the original theory should provide useful predictions regardless of nozzle area ratio. GRA

N80-24277# Bristol Univ. (England). Dept. of Aeronautical Engineering.

AN INVESTIGATION OF THE PERFORMANCE OF A MOTORCYCLE FAIRING B.S. Thesis
P. E. Freathy and J. D. Potter Jun. 1979 43 p refs
(BU-231) Avail: NTIS HC A03/MF A01

The addition of strakes to the fairing of a racing motorcycle to improve handling and stability by decreasing front wheel lift was studied. A full size Suzuki 500 motorcycle was adapted to accept a Yamaha racing fairing and a 1/9th scale model of the Yamaha motorcycle was used in the wind tunnel for force measurements. Flow visualization was used to compare the full scale flow to that over the model. A theoretical analysis of stability was also performed. It was found that the strakes could greatly reduce the lift with no consequent drag penalty. There were no unexpected disturbances in the flow, although one separation line, emanating from the handlebars on the model was not found on the full scale machine. Problems encountered during the course of this project are in included. Author (ESA)

N80-24278# Royal Aircraft Establishment, Farnborough (England).
WIND TUNNEL MEASUREMENTS OF THE MEAN FLOW IN THE TURBULENT BOUNDARY LAYER AND WAKE IN THE REGION OF THE TRAILING EDGE OF A SWEPT WING AT SUBSONIC SPEEDS
P. H. Cook, M. A. McDonald, and M. C. P. Firmin London HMSO Jun. 1979 185 p refs
(RAE-TR-79062; RAE-Aero-3457; BR71526) Avail: NTIS HC A09/MF A01

Measurements were made of the distributions of local Mach number, flow direction, and static pressure coefficient through the wake and boundary layers of a wing of constant chord (0.61 m normal to the leading edge) and RAE 101 section at sweep angles of 20 deg and 28 deg. The model spanned the 1.8 m (6 ft) dimension of the wind tunnel working section and was set at incidences in the range of + or - 1.88 deg. Tests were made at free stream Mach numbers in the range 0.43 to 0.76 and Reynolds numbers of 7 to 11 x 1,000,000. The technique of measurements, using calibrated minature three-hole yawmeters, is described and the experimental results are compared with an integral boundary layer calculation method. Some comparisons are also made with previous tests at zero sweepback. Results indicate that useful data on the behavior of three-dimensional layers and wakes can be obtained by this technique.
Author (ESA)

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

N80-24279# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT: THURMAN L. MUNSON, CESSNA CITATION 501, N15NY, NEAR CANTON, OHIO, AUGUST 2, 1979
16 Apr. 1980 29 p
(NTSB-AAR-80-2) Avail: NTIS HC A03/MF A01

The findings of an investigation of the Cessna Citation 501 accident are presented and analyzed. The probable cause of the accident was the pilot's failure to recognize the need for, and to take action to maintain sufficient airspeed to prevent a stall into the ground during an attempted landing. The pilot also failed to recognize the need for timely and sufficient power application to prevent the stall during an approach conducted inadvertently without flaps extended. Contributing to the pilot's inability to recognize the problem and to take proper action was his failure to use the appropriate checklist and his nonstandard pattern procedures which resulted in an abnormal approach profile. M.G.

N80-24280# National Aviation Facilities Experimental Center, Atlantic City, N. J.
POSTCRASH FUEL FIRE HAZARD MEASUREMENTS IN A WIDE-BODY AIRCRAFT CABIN Final Report, Mar. 1977 - Dec. 1978
Richard G. Hill, George R. Johnson, and Constantine P. Sarkos Dec. 1979 92 p refs Original contains color illustrations
(FAA Proj. 181-521-100)
(AD-A079548; FAA-NA-79-42) Avail: NTIS HC A05/MF A01 CSCL 01/3

Results obtained utilizing a full-scale, wide-body test article for studying postcrash cabin hazards produced by an external fuel fire adjacent to a cabin door opening are described. Seventy-two tests were conducted at various ambient wind conditions and fire sizes in a fire-hardened cabin devoid of interior materials. Temporal data, taken at a large number of cabin locations, are presented and discussed pertaining to the effect of ambient wind on the rate of hazard accumulation inside of the cabin; stratification of heat, smoke, and toxic gases; the effect of fire size of thermal radiation through the opening; and the relative importance of heat, smoke, and carbon monoxide in a fuel-dominant fire. It is concluded that major stratification of hazards occurs in the cabin when the hazards are created by an external fuel fire, and that ambient wind determines the amount of hazards entering a cabin due to a given fuel fire. M.G.

N80-24281# National Aviation Facilities Experimental Center, Atlantic City, N. J.
ADVANCED CONCEPT IN AIRCRAFT CRASH FIREFIGHTING USING CARBON TETRAFLUORIDE Final Report, Oct. 1977 - Jul. 1979
George B. Geyer, Lawrence M. Neri, and Charles H. Urban Mar. 1980 100 p refs Sponsored in part by Air Force
(AD-A082936; FAA-NA-79-43; ESL-TR-79-40) Avail: NTIS HC A05/MF A01 CSCL 13/12

The feasibility of replacing a potentially lethal aircraft cabin environment with a cool habitable atmosphere which is nonsupportive of combustion during passenger evacuation in fire emergencies was investigated. Carbon tetrafluoride (CF4) was chosen as the fire extinguishant because of its very low toxicity and high molecular stability under thermal insult. Four large-scale experiments were performed in a completely instrumented cabin of a DC7 aircraft employing both Class A and B combustable materials. Three experiments were performed using the habitable inert atmosphere (27 volume percent CF4) discharging at the rate of 3,300 cubic feet per minute into the aircraft cabin through a window exit. For comparative purposes, the fourth experiment was performed using neat CF4 discharged from two simulated points of fuselage penetration by a ballistically-powered aircraft skin penetrator nozzle. The CF4-air atmosphere was capable of extinguishing nonsurvivable Class A and B cabin fires within 125 seconds or less during which time the cabin temperature was rapidly reduced and visual acuity slowly improved by smoke dilution during the Class A fire tests. Fire extinguishment by means of neat CF4 at the same discharge rate required approximately twice as long, and visibility within the cabin did not improve during the duration of the experiment. R.E.S.

N80-24282# Naval Air Duvelopment Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
DEVELOPMENT AND TESTING OF AN AUTOMATIC LAP BELT RETRACTION AND RELEASE SYSTEM Interim Report
Marcus Schwartz 25 Jan. 1980 41 p refs
(WF4140000)
(AD-A080950; NADC-79270-60) Avail: NTIS HC A03/MF A01 CSCL 01/3

The consequences of a poor or loosely adjusted restraint system have been well documented and have been shown to cause various crewmember injuries and also to degrade ejection seat performance. An automatic lap belt retraction and seat-man release system has been developed for use with the Navy's Maximum Performance Escape System ejection seat. The lap belt cinch-up device works simultaneously with the action of the inertia reel from independent gas generators, while the lap belt release device work simultaneously with the strap cutter from a common gas generator. In-house testing of improved cinch and release prototype devices is continuing. GRA

N80-24283# Army Natick Research and Development Command, Mass. Clothing Equipment and Materials Engineering Lab.
US ARMY SURVEY OF AIRCREW SURVIVAL KITS/VESTS Final Report
Thomas H. Judge Jan. 1980 101 p
(AD-A081153; CE/MEL-210; NATICK/TR-80/012) Avail: NTIS HC A06/MF A01 CSCL 06/7

For a number of years air crew members have complained of problems with survival kits, vests, and components. These complaints have been debated time and again with no resolution forthcoming to meet the comprehensive crash survival needs of the aircrew members. In an effort to resolve these complaints, a survey was initiated throughout the U.S. Army Aviation Community to identify the problem areas and develop rationale for correction action. This report discusses results of the survey and conferences held following completion of the survey. Medical, Crash, Search and Rescue and Aviation Community Data provided rationale for new approaches to survival kits and vests. These approaches to reduce the amount of present day survival components were modified by each conference and upgraded to improve the aircraft crash survival environment. The reductions in helicopter crash fires and the ability of rescue teams to recover crash survivors in six hours or less has contributed to the need to replace present day nonessential items with only essential, absolute need, survival components. GRA

N80-24284# Textron Bell Helicopter, Fort Worth, Tex.
LATERAL ROLLOVER PROTECTION CONCEPTS Final Report, Oct. 1977 - Aug. 1979
Roy G. Fox Jan. 1980 107 p refs
(Contract DAAJ02-77-C-0078; DA Proj. 1L2-62209-AH-76)
(AD-A081420; USAAVRADCOM-TR-80-D-1) Avail: NTIS HC A06/MF A01 CSCL 01/3

Helicopter accidents in which the aircraft rolled over laterally are costly in aircraft damage. U.S. Army helicopter accident reports involving lateral rollover for a 6 1/2 year period were analyzed to determine their significant characteristics such that design concepts for rollover protection could be identified. The results of the accident analysis were applied to portions of crash survival specifications and design concepts for rollover protection. Dynamic rollover, when the aircraft is light on its landing gear, was investigated using computer simulation to identify pertinent parameters. A quick response from the pilot to reduce main rotor thrust is the primary means available for recovery. A preliminary evaluation of the KRASH computer simulation program was done for the rollover environment. Design concepts that either prevented the occurrence of a rollover accident or minimized the dangers to the occupants as the aircraft rolled over were investigated. An automatic rollover sensing and correction system was investigated. Wing and wide landing gear concepts can provide increased rollover resistance. Means of preventing hazardous main rotor pylon motion during a rollover accident were also investigated. GRA

N80-24285# University of Northern Illinois, De Kalb. Dept. of Biological Sciences.
DEVELOPMENT OF COMPUTER-GENERATED PHENOGRAMS TO FORECAST REGIONAL CONDITIONS HAZARDOUS TO LOW-FLYING AIRCRAFT Final Report, 30 Sep. 1977 - 30 Dec. 1979
William E. Southern Dec. 1979 102 p refs
(Grant AF-AFOSR-3431-77; AF Proj. 2312)
(AD-A081869; AFOSR-80-0175TR) Avail: NTIS HC A06/MF A01 CSCL 01/2

Collisions or strikes between birds and aircraft that occur annually across the United States result in damages amounting to millions of dollars and considerable risk to crew members. Gulls are involved in more strikes than any other group of avian species. USAF aircraft are vulnerable to birdstrikes during take-off, while landing, and during low-altitude missions. This report describes monthly patterns of gull distribution across the United States and provides a statistical model for predicting the probability of one or more birdstrikes occurring. The accuracy of such predictions is dependent upon the input data for the model being as complete as possible. In addition, the data should be for the specific geographical area for which the prediction is desired. The following types of data are needed: (1) an estimate of the number of birds present in the area; (2) the number of missions flown in the area; and (3) the number of strikes previously recorded in the area. With this information at hand, it is possible to determine how a change either in the number of missions flown or in the concentration of birds present will affect the probability of a birdstrike occurring. GRA

N80-24286# Interaction Research Corp., Stanton, Calif.
AN INVESTIGATION OF FACTORS AFFECTING AIRCRAFT PASSENGER ATTENTION TO SAFETY INFORMATION PRESENTATIONS Final Report, Nov. 1978 - Apr. 1979
Daniel A. Johnson Aug. 1979 32 p refs
(Contract DOT-FA78WA-4095)
(AD-A082358; IRC-79-1) Avail: NTIS HC A03/MF A01 CSCL 01/2

Many commercial aircraft passengers do not appear to attend to the safety information presentation given prior to takeoff. This presentation, in the form of the oral briefing given by the flight attendant and the safety information cards, supplies information the passenger may need to increase the probability of safely surviving an aircraft emergency. A questionnaire was administered to 255 respondents who had flown at least twice in the previous two years. A number of factors associated with the way the information is presented, the apparent response of other passengers to the presentation, perceived accident probability, relative adequacy of the oral briefing, and situational and demographic variables are related to whether the passenger reports attending or not attending to the safety presentation. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also 17 Spacecraft Communications, Command, and Tracking and 32 Communications.

N80-24287# Federal Aviation Administration, Washington, D. C. Systems Research and Development Service.
ENGINEERING AND DEVELOPMENT PROGRAM PLAN: EN ROUTE CONTROL, PROGRAM 12
Nov. 1979 57 p
(AD-A082471; FAA-ED-12-2B) Avail: NTIS HC A04/MF A01 CSCL 17/7

Implementation of the third generation en route air traffic control system, model A3d2, provides basic automation capability for processing flight data and surveillance functions. Substantial upgrading of this basic capability is needed to meet the demand forecast for the en route system through the 1980's. The development plan to build the features and functions necessary for upgrading the present third generation en route system is described. Program objectives, development activities, implementation considerations, and resource estimates are set forth.R.E.S.

N80-24288# Mitre Corp., McLean, Va. Metrek Div.
PRELIMINARY COMPUTER SIZING ESTIMATES FOR AUTOMATED EN ROUTE ATC (AERA)
H. Gilbert Miller Oct. 1979 38 p
(Contract DOT-FA80WA-4370)
(AD-A082628; MTR-79W00263; FAA-EM-79-21) Avail: NTIS HC A03/MF A01 CSCL 17/7

An analysis that estimates the computer sizing requirements imposed by the Automated En Route Air Traffic Control (AERA) system, a possible long-term enhancement to National Aviation System, is presented. In order to establish preliminary AERA processor and memory requirements, two models are presented. A simulation model of the higher level AERA functions, such as initial processing and progress monitoring, is applied to the Washington Center to show typical AERA imposed processor loading. A previously developed linear model of required memory is also applied to show typical memory requirements resulting from AERA. The models presented reflect a version of AERA did not include the recently developed concepts of strategic and tactical planning/control. Additionally, since AERA will continue to evolve during the development stage, requirements enumerated

must be considered preliminary in nature and significant changes on the estimates may be expected. R.E.S.

N80-24289# Electronics Engineering Group (1842nd), Scott AFB, Ill. Support Engineering Branch.
RADAR APPROACH CONTROL (RAPCON) PRIMARY INPUT POWER SUPPLY STUDY
Robert L. Boyce 15 Aug. 1979 25 p
(AD-A074080; Rept-1842EEG/EEISG-TR-79-15) Avail: NTIS HC A02/MF A01 CSCL 17/7

Equipment failure data was collected from 52 representative sites (with and without voltage regulators) for a period of 12 months to determine whether or not equipment failures were less while using voltage regulators on RAPCON ac power supplies. No correlation could be found between reduced failures and the use of voltage regulators. The equipment failure rates at sites with regulated power supplies, compared to those sites with unregulated power supplies were approximately the same, except that indicator scopes located at sites with unregulated power supply systems had a lower failure rate. It was also found that seven of the ten highest failure incidence sites had regulated input power. Failure rates were found to be at, or below, the specified MTBF of the equipment. Recommendations are included. A.R.H.

N80-24290# Royal Aircraft Establishment, Farnborough (England).
PERFORMANCE OF OMEGA H-FIELD ANTENNAS RECESSED INTO AIRFOILS
E. A. Blake and I. D. Birch London HMSO May 1979 121 p refs
(RAE-TR-79048; RAE-RAD-NAV-78; BR70238) Avail: NTIS HC A06/MF A01

The use of an H-field Omega antenna recessed below an airfoil surface was investigated. Theoretical and experimental aspects are discussed together with ground and flight test results of a practical installation. The mounting configuration is shown to be fully viable and is thought to have wide application to both civil and military aircraft. Author (ESA)

N80-24291# Royal Aircraft Establishment, Farnborough (England).
WIND-SHEAR ENCOUNTERS DURING VISUAL APPROACHES AT NIGHT. A PILOTED SIMULATOR STUDY
P. L. Biegood, J. W. Britton, and H. Y. Ratcliffe (Cranfield Inst. of Tech.) London HMSO Sep. 1979 64 p refs
(RAE-TR-79126; RAE-FS-112; BR71911) Avail: NTIS HC A04/MF A01

A study was made in a fixed-base simulator of encounters with a variety of idealized wind shears under conditions simulating a two-pilot approach, partly on instruments and partly visual, made at night were studied in a fixed-bed simulator. Twenty-five pilots, airline and service, participated completing a total of 62 sorties, each of ten approaches. There were four shear encounters per sortie. The data comprized time-histories of each approach together with the pilots responses to a datailed questionnaire and their spontaneous observation. Results show that pilots are successful in recognizing the absence of shear or the presence of severe shear. They are less successful in recognizing shears of moderate intensity or in identifying the velocity components. To cope effectively with the shears, pilot action must be both prompt and appropriate and it is clear that pilots were quick to seek clues that might offer 'early warning' of impending shear. It seems likely that the inclusion of shear encounters during routine simulator training can prove beneficial. Author (ESA)

N80-24292# Royal Signals and Radar Establishment, Malvern (England).
PRECISION NAVIGATION FOR AIR TRAFFIC MANAGEMENT
S. Ratcliffe London HMSO Oct. 1978 9 p refs Presented at 29th AGARD/GCP Symp., Copenhagen, Oct. 1979
(RSRE-Memo-3220; BR72506) Avail: NTIS HC A02/MF A01

The problems that would arise if airspace users had the use of NAVSTAR, or some other position-fixing aid, and the uses that Air Traffic Control (ATC) could, or could not, make of this capability are discussed. There would be formidable transitional problems in the vertical plane, because NAVSTAR measures height from the Earth's center whereas current altimeters measure atmospheric pressure. In either vertical or horizontal planes much work is necessary to prove that the separation standards can be reduced at all. Changes that might be possible in the ATC system should appreciable reductions in separation standards prove possible are suggested. A collision avoidance system based on either the broadcast coordinates of each aircraft, or on a time-frequency basis using NAVSTAR as the time reference is proposed. The latter scheme would offer protection to a fully-equipped aircraft against another that could not afford the expense of a NAVSTAR fit. Author (ESA)

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.
For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

N80-24293*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A CANDIDATE V/STOL RESEARCH AIRCRAFT DESIGN CONCEPT USING AN S-3A AIRCRAFT AND 2 PEGASUS 11 ENGINES
Bedford A. Lampkin May 1980 24 p refs
(NASA-TM-81204; A-8197) Avail: NTIS HC A02/MF A01 CSCL 01C

A candidate V/STOL research aircraft concept which uses an S-3A airframe and two Pegasus 11 engines was studied to identify a feasible V/STOL national flight facility that could be obtained at the lowest possible cost for the demonstration of V/STOL technology, inflight simulation, and flight research. The rationale for choosing the configuration, a description of the configuration, and the capability of a fully developed aircraft are discussed. R.E.S.

N80-24294*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WIND-TUNNEL TESTS OF THE XV-15 TILT ROTOR AIRCRAFT
James A. Weiberg and Martin D. Maisel Apr. 1980 133 p refs Prepared in cooperation with Army Research and Technology Labs., Moffett field, Calif.
(NASA-TM-81177; AVRADCOM-TR-80-A-3; A-8089) Avail: NTIS HC A07/MF A01 CSCL 01C

The XV-15 aircraft was tested in the Ames 40 by 80 Foot Wind Tunnel for preliminary evaluation of aerodynamic and aeroelastic characteristics prior to flight. The tests were undertaken to investigate the aircraft performance, stability, control and structural loads for flight modes from helicopter through transition and airplane mode up to the tunnel capability of 170 knots. Results from these tests are presented. Author

N80-24295*# Kansas Univ. Center for Research, Inc., Lawrence.
COMPARISON OF THEORETICALLY PREDICTED LATERAL-DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH FULL-SCALE WIND TUNNEL DATA ON THE ATLIT AIRPLANE
Michael Griswold and J. Roskam May 1980 213 p refs (Grant NsG-1574)
(NASA-CR-163189; KU-FRL-399-2) Avail: NTIS HC A10/MF A01 CSCL 01C

An analytical method is presented for predicting lateral-directional aerodynamic characteristics of light twin engine propeller-driven airplanes. This method is applied to the Advanced Technology Light Twin Engine airplane. The calculated characteristics are correlated against full-scale wind tunnel data. The method predicts the sideslip derivatives fairly well, although angle of attack variations are not well predicted. Spoiler performance was predicted somewhat high but was still reasonable. The rudder derivatives were not well predicted, in particular the effect of angle of attack. The predicted dynamic derivatives could not be correlated due to lack of experimental data. J.M.S.

N80-24296*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASUREMENT OF AIRCRAFT SPEED AND ALTITUDE
William Gracey May 1980 311 p refs
(NASA-RP-1046; L-12610) Avail: NTIS HC A14/MF A01 CSCL 01C

Problems involved in measuring speed and altitude with pressure-actuated instruments (altimeter, airspeed indicator, true-airspeed indicator, Machmeter, and vertical-speed indicator) are examined. Equations relating total pressure and static pressure to the five flight quantities are presented, and criteria for the design of total and static pressure tubes are given. Calibrations of typical static pressure installations (fuselage nose, wing tip, vertical fin, and fuselage vent) are presented, various methods for flight calibration of these installations are described, and the calibration of a particular installation by two of the methods is described in detail. Equations are given for estimating the effects of pressure lag and leaks. Test procedures for the laboratory calibration of the five instruments are described, and accuracies of mechanical and electrical instruments are presented. Operational use of the altimeter for terrain clearance and vertical separation of aircraft is discussed, along with flight technical errors and overall altitude errors of aircraft in cruise operations. Altitude-measuring techniques based on a variety of properties of the Earth and the atmosphere are included. Two appendixes present airspeed and altitude tables and sample calculations for determining the various flight parameters from measured total and static pressures. R.E.S.

N80-24297# Air Force Geophysics Lab., Hanscom AFB, Mass. Meteorology Div.
ICING NOZZLE ELEMENT OPTIMIZATION TEST, JANUARY 1979 Final Report
Leandro V. Delgado 20 Aug. 1979 370 p refs
(AD-A081175; AFGL-TR-79-0193) Avail: NTIS HC A12/MF A01 CSCL 14/2

An MC-130E instrumented by AFGL for cloud physics research flew a series of tests behind a KC-135 specially modified with a multi-element spray nozzle. The tests, for Air Force Flight Test Center, were to sample and define the spray plume produced by the nozzle at specified values of water flow rate, distance from nozzle, and temperature. PMS spectrometers were used to sample the artificial cloud. Data were analyzed to produce sample average and instantaneous 1 sec particle size spectra with liquid water content values. Comparison of values of liquid water content, water flow rate, and distance from nozzle to instrument indicate well defined linear relationships. Instantaneous 1 sec liquid water content values indicate a variance in the uniformity across the spray. Maximum, minimum, mean, and standard deviation values are provided for each sample to characterize the variance. Although many of the particles had round shapes, it was not possible to tell from the instrumentation whether the particles were ice or water drops. GRA

N80-24298# Sikorsky Aircraft, Stratford, Conn.
MM&T FIBER REINFORCED PLASTIC HELICOPTER TAIL ROTOR ASSEMBLY (PULTRUDED SPAR) Final Report, 29 Aug. 1975 - 30 Oct. 1978
Maron J. Bonassar and John J. Lucas Jan. 1980 181 p ref
(Contract DAAJ02-76-C-0001)
(AD-A082352; SER-70286; USAAVRADCOM-TR-79-45) Avail: NTIS HC A09/MF A01 CSCL 01/3

This program was directed at establishing the pultrusion process for the manufacture of helicopter tail rotor spars as a means of lowering manufacturing cost without sacrificing structural performance and keeping design changes to a minimum. The pultrusion process capability was successfully demonstrated by designing, fabricating, and testing a full-size tail rotor spar assembly for the YUH-60A prototype helicopters. Although the pultrusion process was determined to be a viable manufacturing fabrication method, the program was terminated prior to completion because the cost effectiveness and producibility of the pultrusion process as compared with present UH-60A BLACK HAWK production techniques are not sufficiently significant to warrant a change in manufacturing fabrication method at this time. GRA

N80-24299# Douglas Aircraft Co., Inc., Long Beach, Calif.
PRIMARY ADHESIVELY BONDED STRUCTURE TECHNOLOGY (PABST). DESIGN HANDBOOK FOR ADHESIVE BONDING Final Report, 15 Mar. 1977 - Jan. 1979
D. L. Potter Wright-Patterson AFB, Ohio AFFDL Nov. 1979 192 p refs
(Contract F33615-75-C-3016; AF Proj. 486U)
(AD-A082078; MDC-J6076; AFFDL-TR-79-3129) Avail: NTIS HC A09/MF A01 CSCL 11/1

The Air Force Primary Adhesively Bonded Structure Technology (PABST) Program was started in February 1975 for the purpose of validating the concept of adhesive bonding primary fuselage structural members together in lieu of the use of rivets. The goal of the program was to provide a cost saving of 20 percent of the acquisition and maintenance cost of ownership. It was further desired to show a 15 percent weight saving for the bonded assemblies. The program is now complete and the damage tolerance and durability of bonded structure has been shown to exceed, by far, that of riveted structure. Also the cost and weight savings goals appear to be obtainable for a production article. The design guidelines for a bonded primary structure are presented. The complete design criteria are identified for successfully developing bonded primary structure. It includes the fatigue, damage tolerance, and fail-safe criteria for both the metallic structure and adhesive bond area. A section discusses the material selection requirements, and another one presents the manufacturing considerations required to properly bond the primary structure. A review of the inspection needs is presented followed by a discussion of the repairability of the bonded structure. The cost and weight analysis reviews the methods used to determine results obtained on the program. A complete section covers the loads, load transfer, and failure modes of bonded joints and this is followed by an analysis section which describes numerical methods for analyzing all manner of bonded joints with and without adjacent metal flaws. The final section in the report discusses the types of tests and associated specimens needed to properly select an adhesive for use in a bonded primary structure. GRA

N80-24300# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
A CASE FOR VATOL FLIGHT DEMONSTRATION
C. Joseph Martin Jan. 1980 33 p refs Presented at the V/STOL Aircraft Aerodyn. Meeting, Monterey, Calif, 16-18 May 1979
(ZF66421001)
(AD-A082179; DTNSRDC/AERO-1264; DTNSRDC-80/018) Avail: NTIS HC A03/MF A01 CSCL 01/3

This paper reviews the work on the Vertical Attitude Takeoff and Landing (VATOL) technology development. Studies of vertical and short takeoff and landing aircraft have shown a significant advantage in payload or performance for the vertical attitude concept. The additional payoff from the incorporation of Post-Stall Combat Maneuvering is identified. The VATOL post-stall control system that requires control at high angle-of-attack, provides a decisive combat advantage over a conventional fighter. The planning for post-stall aerodynamic studies at DTNSRDC and NASA Ames is presented. This includes a large powered model to be tested in the NASA 40 x 80 foot wind tunnel. Progress toward a moving base simulation of the vertical attitude landing is reviewed. Results of design studies indicating the feasibility of a VATOL research aircraft, using an existing propulsion system are outlined along with a possible configuration for an advanced VATOL fighter that incorporates a novel control system. GRA

N80-24301# RAND Corp., Santa Monica, Calif.
FUTURE V/STOL AIRPLANES: GUIDELINES AND TECHNIQUES FOR ACQUISITION PROGRAM ANALYSIS AND EVALUATION. EXECUTIVE SUMMARY
J. R. Nelson, J. R. Gebman, J. L. Birkler, R. W. Hess, P. Konoske-Dey, and W. H. Krase Feb. 1980 44 p refs
(Contract MDA903-77-C-0107)
(AD-A081922; RAND/R-2397-PA/E; ISBN-0-8330-0166-3; LC-79-22274) Avail: NTIS HC A03/MF A01 CSCL 01/3

The purpose of this summary report and a companion technical document (AD-B044 537) is to assist the Department of Defense in making critical evaluations of proposed vertical/short takeoff and landing (V/STOL) airplane program characteristics, including

airplane performance, acquisition schedule, and acquisition cost. The guidelines and techniques described in these two documents take the form of analytical tools, data, and lessons drawn from previous V/STOL airplane research, development and acquisition experience. The documents focus exclusively on the acquisition phase for the airframe and the propulsion subsystems; avionics is not considered. The operational utility of V/STOL airplanes and the possible new missions to which V/STOL airplanes might be uniquely suited are not addressed. GRA

N80-24302# Sikorsky Aircraft, Stratford, Conn.
ADVANCED COMPOSITE ROTOR HUB PRELIMINARY DESIGN Final Report, Oct. 1977 - Jul. 1979
Elliot F. Olster Jan. 1980 193 p refs
(Contract DAAJ02-77-C-0056; DA Proj. 1L2-62209-AH-76)
(AD-A081951; USARTL-TR-78-53) Avail: NTIS HC A09/MF A01 CSCL 01/3

The design requirements for a UH-60A (BLACK HAWK) main rotor hub are presented. A series of six composite hub configurations were evaluated. The evaluation included a comparison to the design requirements as well as additional goals such as reduced weight, cost, radar cross section, use of existing rotor head components, etc. The best of these hub concepts was subsequently refined and reanalyzed. The results of this study indicated the following: (1) A composite rotor hub can reduce the weight of an equivalent metal hub by up to 15%, (2) The production and acquisition costs of a composite hub are 20% less than its metal counterpart, (3) The life-cycle cost analysis indicated that $690K could be saved if the hub were in production by January 1983. The life-cycle cost savings are significantly affected by the 'introduction time', and a 6-month delay would negate the cost savings, and (4) For other benefits, such as an alternate source in case of a shortage of titanium, or to generate limited, in-service, maintenance and repair data on a composite hub, a continued effort was recommended. GRA

N80-24303# Grumman Aerospace Corp., Bethpage, N.Y.
INTEGRATED RACK CONCEPT STUDY FOR V/STOL TYPE AIRCRAFT Final Report, 1 Oct. 1978 - 1 Dec. 1979
E. V. Ramirez, B. Borgenson, A. Caserta, V. Cirrito, and R. Dahl Jan. 1980 205 p
(Contract N62269-78-R-0294)
(AD-A081984; NADC-78113-60) Avail: NTIS HC A10/MF A01 CSCL 01/3

Six different rack concepts were investigated for determining the most optimum configuration of packaging the avionic equipment on A and B type V/STOL aircraft. The two basic approaches of cooling the rack considered were air impingement and conduction cooled. As a baseline, two module configurations were used; an Improved Standard Electronic Module-2A, and Hollow Core Design with an ISEM-2A form factor. The modules, utilizing chip carrier semiconductor devices, were assumed to dissipate 5 to 10 watts. The rack power system makes use of Solid State Electric Logic (SOSTEL) power management elements. A parametric thermal analysis with junction temperatures from 60 to 125 C was performed. Each of the following disciplines, Mechanical, EMI, ECS, Reliability; Maintainability and Life Cycle Costs were also considered in the design of the racks. A Sensitivity Evaluation Program was used to select the most viable approaches. GRA

N80-24304# Foster-Miller Associates, Inc., Waltham, Mass.
ANALYSIS OF TRUNK FLUTTER IN AN AIR CUSHION LANDING SYSTEM: USER'S MANUAL Final Report, May 1978 - Jul. 1979
Roger B. Fish Wright-Patterson AFB, Ohio AFFDL Nov. 1979 179 p
(Contract F33615-78-C-3412; AF Proj. 2307)
(AD-A082087; AFFDL-TR-79-3121) Avail: NTIS HC A09/MF A01 CSCL 01/3

This User's Manual (Computer Program) describes the computer programs for trunk flutter analysis. It includes descriptions, user instructions, and a sample run for the trunk flutter dynamic simulation program, and an eigenvalue calculation program for a linearized static trunk model. GRA

N80-24305# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
ARTIFICIAL ICING TEST CH-47C HELICOPTER WITH FIBERGLASS ROTOR BLADES Final Report, Jan. - Mar. 1979
John R. Niemann, Frame J. Bowers, III, and Sherwood C. Spring Jul. 1979 56 p
(AD-A081860; USAAEFA-78-18) Avail: NTIS HC A04/MF A01 CSCL 01/3

The United States Army Aviation Engineering Flight Activity, in conjunction with the Boeing Vertol Company, conducted an evaluation of the CH-47C helicopter with fiberglass rotor blades and a prototype blade de-ice system. The rotor blades were tested under natural and artificial icing conditions at St. Paul, Minnesota from 24 January to 2 March 1979, and required 30.1 flight hours of which 17.7 hours were in an icing environment. Testing was conducted in two phases: (1) protected, where the blade de-ice system was allowed to operate automatically and (2) unprotected, where the blade de-ice system was held in standby status. The fiberglass rotor blade system was evaluated at conditions varying from 0.1 gm cu m liquid water content (LWC) to 0.8 gm cu m LWC and temperatures varying from -4 C to -16 C. Time in the icing environment varied from a minimum of 28 minutes to a maximum of 2 hours and 25 minutes. The protected rotor blade de-ice system operated satisfactorily. The unprotected rotor blades operated satisfactorily under the limited conditions tested. Minimal ice accretion and minimal asymmetric shed characteristics were observed. Two deficiencies for flight under icing conditions unrelated to the fiberglass rotor blades were noted. The deficiencies are: (1) failure of the droopstops to engage after flight in icing conditions; and (2) ice accretion and subsequent blockage of the fuel vents. GRA

N80-24306# General Dynamics Corp. Fort Worth, Tex.
V/STOL PROPULSION-INDUCED AERODYNAMICS HOVER CALCULATION METHOD Final Technical Report, 19 Jan. 1979 - 19 Jan. 1980
W. H. Foley and J. A. Sansone Feb. 1980 133 p refs
(Contract N62269-79-C-0212)
(AD-A082688; NADC-78242-60) Avail: NTIS HC A07/MF A01 CSCL 20/4

An empirical method has been developed to predict the propulsive-induced forces on a V/STOL aircraft hovering in proximity of the ground. This method is applicable to configurations employing two, three, or four circular exhausts. Planform contour, nozzle pressure ratio, and lift improvement devices are considered. Accuracies on the order of one percent of propulsive thrust are demonstrated. GRA

N80-24307# Northrop Corp., Hawthorne, Calif.
HYBRID COMPUTER ERRORS IN ENGINEERING FLIGHT SIMULATION Final Report, 15 May 1978 - 15 Aug. 1979
Richard A. Weeks Wright-Patterson AFB, Ohio AFFDL Aug. 1979 128 p refs
(Contract F33615-78-C-3608; AF Proj. 2307)
(AD-A081953; NOR-79-89; AFFDL-TR-79-3091) Avail: NTIS HC A07/ MF A01 CSCL 20/4

A real-time airframe simulation was constructed with an all analog, hybrid-single Central Processing Unit (CPU), hybrid-dual CPUs with shared common memory, hybrid-dual CPUs with an Input/Output serial link, and all digital computer configurations so as to investigate the effects of various computer error sources on solution accuracy. The airframe simulation represented three degrees-of-freedom of longitudinal motion such that effects of error sources on both short period and phugoid motion could be observed. The error analysis utilized Fast Fourier Transforms which showed how the Power Spectra of the transient airframe response distorted (relative to a theoretical response) when contaminated with error sources. GRA

N80-24308# Neilsen Engineering and Research, Inc., Mountain View, Calif.
THE RAPID PREDICTION OF AIRCRAFT STORE LOADING DISTRIBUTION AT TRANSONIC SPEEDS, PART 2 Final Report, 1 Jan. 1975 - 30 Sep. 1979
Anthony J. Crisalli, Stephen S. Stahara, and Michael J. Hemsch Oct. 1979 82 p refs
(Contract F44620-75-C-0047; AF Proj. 2307)
(AD-A082005; NEAR-TR-204-Pt-2; AFOSR-79-1282TR-Pt-2)
Avail: NTIS HC A05/MF A01 CSCL 20/4

An account is provided for the progress made in the development of an engineering predictive method for determining loading distributions on external stores located in the three dimensional transonic flow field of a parent aircraft. Attention has been directed toward developing accurate but rapid methods for predicting store loadings in transonic flow fields generated by wing-body/pylon combinations representative of modern fighter-bomber aircraft. Detailed evaluations, based on extensive comparisons with experimental data obtained from a parallel wind-tunnel test phase of the program, are presented for two store loading prediction methods. Results are provided for various wing-body/pylon/store configurations for flow conditions throughout the transonic regime. GRA

N80-24309# Boeing Military Airplane Development, Seattle, Wash.
DESIGN OPTIONS STUDY Final Report
E. A. Barber, D. G. Blattner, R. J. Marhefka, M. Fligstein, and E. J. LaKous 29 Feb. 1980 161 p refs
(Contract F33615-78-C-0114)
(AD-A082941; D180-24258-3) Avail: NTIS HC A08/MF A01 CSCL 01/3

This study considered a number of desired military features applied to a new commercial freighter and examined the commercial operating cost penalties and military life cycle costs. An I.O.C. of 1990 is projected for the new commercial freighter aircraft and the military design options, based upon a 1985 technology maturity date for the key technologies. The baseline aircraft incorporates graphite epoxy primary structure, active flight controls, advanced engines and aircraft systems. It appears that use of the dedicated commercial freighter uncompromised, but with selective military loading preprogrammed to optimize unit payloads, can provide a major portion of the airlift with only a minor increase in the organic fleet. One of the most pervasive influences in the study was the cost of the Enhanced CRAF provisions on the Design Options airplanes. Commercial pricing was used for both the baseline airplane and the provisions. However, because the CRAF provisions were developed and procured on a small unit buy relative to the baseline airplane the relative cost of the CRAF provisions are high, and significantly influence the results. GRA

N80-24310# Royal Aircraft Establishment, Farnborough (England).
MEASUREMENT OF MOMENTS OF INERTIA AND PRINCIPAL INERTIA AXIS OF A GNAT AIRCRAFT Final Report
R. L. Poulter London HMSO Jul. 1979 27 p refs
(RAE-TR-79090; RAE-FS-106; BR70939) Avail: NTIS HC A03/MF A01

The modifications made to a ground rig used to measure moments of inertia and the technique developed to minimize errors in the moment of inertia in roll are described. Calibration of the rig shows that acceptable accuracies are obtained while results for the moments of inertia in roll and pitch as well as the inclination of the principal inertia axis of the Gnat aircraft are given. Three fuel states, empty, external tanks full, and internal tanks full, were tested, comparisons being made with estimated values where possible. Author (ESA)

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N80-24311# Human Engineering Labs., Aberdeen Proving Ground, Md.
A DYNAMIC EVALUATION OF THE INTEGRATED AVIONICS CONTROL SYSTEM (IACS) Final Report
William B. DeBellis Feb. 1980 54 p
(AD-A082203; HEL-TM-2-80) Avail: NTIS HC A04/MF A01 CSCL 01/4

The Integrated Avionics Control System (IACS) was developed to reduce crew member workload and save cockpit space by controlling all airborne communication systems from a single control panel. This investigation compares the IACS with a suite of standard communication radios through the use of computer graphics, mockups, and hardware. It was concluded (1) that there is a definite savings in cockpit space, (2) the crew workload is reduced, and (3) cockpit 'bookkeeping' related to communications is a significant portion of the workload. GRA

N80-24312# Arinc Research Corp., Annapolis, Md.
STANDARD AVIONICS PACKAGING, MOUNTING, AND COOLING BASELINE STUDY Final Report, Jun. 1979 - Jan. 1980
S. Baily, A. Jackson, J. Russell, C. N. D. Smith, and N. Sullivan Jan. 1980 219 p
(Contract F33657-79-C-0717; AF Proj. 2257)
(AD-A082166; Rept-1753-01-1-2124) Avail: NTIS HC A10/MF A01 CSCL 01/3

This is the final report on a study concerning the development of an avionics packaging, mounting, and environmental (PME) standard and an associated cost-benefit analysis. The report compares military and commercial airlines avionics generic standards to determine their technical and procedural differences and identifies the changes and waivers required when equipment built to the commercial airlines standards are procured by the USAF. It also compares the functional and physical characteristics of certain military and commercial avionics equipments and assesses the degree of utility of current commercial equipments for use in USAF aircraft. The opinions of aircraft and avionics manufacturers concerning a military avionics PME standard and their suggestions as to what the standard's scope an applicability should be, are reported. Alternative avionics cooling procedures and technologies and the concept of employing a separate environmental control system dedicated to avionics cooling are reviewed. A life-cycle cost payback model that addresses the impact of PME standardization on the cost of avionics systems in USAF aircraft is described. The results of exercising the model are reported. The significant tasks and scheduling for the next phases of avionics PME development, leading to the definition and acceptance of a military avionics PME standard, are presented. GRA

N80-24313# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
HELICOPTER REMOTE WIND SENSOR FLIGHT TEST
David H. Dickson and Jon E. Ottesen Feb. 1980 54 p refs
(DA Proj. 1L1-62111-AH-71)
(AD-A082770; ERADCOM/ASL-TR-0051) Avail: NTIS HC A04/MF A01 CSCL 14/2

A flight test program has been completed in which the Helicopter Remote Wind Sensor was mounted on a UH-1 testbed aircraft. Wind measurements were made and recorded under a variety of flight hover conditions. Data from the flight test program are presented as wind profiles as a function of range, and data reduction and analysis approaches are discussed. The point-pair method was applied for comparison to theoretical and wind tunnel results. The data are applied to a baseline ballistics study sufficient to estimate the quantity of data needed for free-flight aerial armaments. GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N80-24314*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF SEVERAL INFLOW CONTROL DEVICES FOR FLIGHT SIMULATION OF FAN TONE NOISE USING A JT15D-1 ENGINE
J. G. McArdle, W. L. Jones, L. J. Heidelberg, and L. Homyak

1980 45 p refs Presented at the 6th Aeroacoustics Conf., Hartford, 4-6 Jun. 1980; sponsored by AIAA
(NASA-TM-81505; E-443) Avail: NTIS HC A02/MF A01 CSCL 21E

To enable accurate simulation of in-flight fan tone noise during ground static tests, four devices intended to reduce inflow disturbances and turbulence were tested with a JT15D-1 turbofan engine. These inflow control devices (ICD's) consisted of honeycomb/screen structures mounted over the engine inlet. The ICD's ranged from 1.6 to 4 fan diameters in size, and differed in shape and fabrication method. All the ICD's significantly reduced the BPF tone in the far-field directivity patterns, but the smallest ICD's apparently introduced propagating modes which could be recognized by additional lobes in the speeds; at supersonic fan tip speed the smallest ICD's had some measurable loss, but the largest had no loss. Data from a typical transducer show that the unsteady inflow distortion modes (turbulence) were eliminated or significantly reduced when either of the ICD's was installed. However, some steady inflow distortion modes remained. A.R.H.

N80-24315*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QCSEE UTW ENGINE POWERED-LIFT ACOUSTIC PERFORMANCE
I. J. Loeffler, N. E. Samanich, and H. E. Bloomer 1980 35 p refs Presented at the 6th Aeroacoustics Conf., Hartford, 4-6 Jun. 1980; sponsored by the AIAA
(NASA-TM-81504; E-442) Avail: NTIS HC A03/MF A01 CSCL 21E

Powered-lift acoustic test of the Quiet Clean Short Haul Experimental Engine (QCSEE) under the wing (UTW) engine are reported. Propulsion systems for two powered-lift concepts were designed, fabricated, and tested. In addition to low noise features, the designs included composite structures, gear-driven fans, digital control, and a variable pitch fan (UTW). The UTW engine was tested in a static ground test facility with wing and flap segments to simulate installation on a short haul transport aircraft of the future. Powered-lift acoustic performance of the UTW engine is compared with that of the previously tested and reported QCSEE over-the-wing (OTW) engine. Both engines were slightly above the noise goal but were significantly below current FAA and modern wide-body jet transport levels. The UTW system in the powered-lift mode was penalized by reflected engine noise from the wing and flap system, while the OTW system was benefitted by a wing noise shielding effect. J.M.S.

N80-24316*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADVANCED COMPONENT TECHNOLOGIES FOR ENERGY-EFFICIENT TURBOFAN ENGINES
Neal T. Saunders 1980 19 p refs Presented at the 16th Joint Propulsion Conf., Hartford, 30 Jun. - 2 Jul. 1980; cosponsored by AIAA, ASME and SAE
(NASA-TM-81507; E-445) Avail: NTIS HC A02/MF A01 CSCL 21E

A cooperative government-industry effort, the Energy Efficient Engine Project, to develop the advanced technology base for future commercial development of a new generation of more fuel conservative turbofan engines for airline use is described. Engine configurations that are dependent upon technology advances in each major engine component are defined and current design and development of the advanced components are included. J.M.S.

N80-24317*# Alabama Univ., University. Engineering Experiment Station.
DEVELOPMENT OF BASIC THEORIES AND TECHNIQUES FOR DETERMINING STRESSES IN ROTATING TURBINE OR COMPRESSOR BLADES Final Report
C. H. Chien, W. F. Swinson, J. L. Turner, F. A. Moslehy, and W. F. Ranson May 1980 158 p refs
(Grant NsG-3233)
(NASA-CR-163190) Avail: NTIS HC A08/MF A01 CSCL 21E

A method for measuring in-plane displacement of a rotating structure by using two laser speckle photographs is described. From the displacement measurements one can calculate strains and stresses due to a centrifugal load. This technique involves making separate speckle photographs of a test model. One photograph is made with the model loaded (model is rotating); the second photograph is made with no load on the model (model is stationary). A sandwich is constructed from the two speckle photographs and data are recovered in a manner similar to that used with conventional speckle photography. The basic theory, experimental procedures of this method, and data analysis of a simple rotating specimen are described. In addition the measurement of in-plane surface displacement components of a deformed solid, and the application of the coupled laser speckle interferometry and boundary-integral solution technique to two dimensional elasticity problems are addressed. M.G.

N80-24318# RAND Corp., Santa Monica, Calif.
AN APPROACH TO THE LIFE-CYCLE ANALYSIS OF AIRCRAFT TURBINE ENGINES Interim Report
J. R. Nelson Dec. 1979 62 p refs
(AD-A080930; RAND/N-1337-AF) Avail: NTIS HC A04/MF A01 CSCL 21/5

A paper prepared for the AGARD/NATO Lecture Series, 'The Application of Design to Cost and Life-Cycle Cost to Aircraft Engines,' is scheduled for May 1980. A methodology is described for life-cycle analysis of aircraft turbine engines from historical data. The methodology enables the weapon-system planner to acquire early visibility of cost magnitudes, proportions, and trends associated with a new military engine's life cycle, and to identify 'drivers' that increase cost and can lower capability. The methodology is applied at the engine subsystem and aircraft system levels for a military fighter aircraft to demonstrate that decisions about engine performance/schedule/cost must be made at the system level. Commercial considerations are discussed, as is limited historical experience in engine monitoring, an approach to obtaining the necessary information and procedures for performance and cost feedback to the engine designer. This note presents portions of previously published Rand work on life-cycle analysis of aircraft turbine engines and engine monitoring systems, together with some recent unpublished work applying the earlier efforts at the aircraft system level. GRA

N80-24319# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
SHOCK WAVE THERMOMECHANICAL PROCESSING OF AIRCRAFT GAS TURBINE DISK ALLOYS Final Technical Report, Jul. 1978 - Jul. 1979
John M. Robertson, James W. Simon, and Thomas D. Tillman Aug. 1979 54 p refs
(Contract N00019-78-C-027C)
(AD-A082080; FR-11992) Avail: NTIS HC A04/MF A01 CSCL 11/6

This program was conducted to assess the effects of shock wave thermomechanical processing on nickel-base (Ni) gas turbine disks. In particular, the peak pressure limit on shaped subscale turbine disks was determined based on allowable permanent deformation and fracture. Using maximum pressure and selected shock/heat-treat schedules, the effect on mechanical properties was determined with results indicating an enhancement of strength, particularly the yield strength, with only a slight decrease in ductility. In general, low-cycle fatigue (LCF) life was not significantly affected, however, two samples tested showed a 3X improvement in life. In addition, two shock/heat-treat schedules were found to be extremely beneficial and will be investigated further. GRA

N80-24320# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group
THERMAL RESPONSE TURBINE SHROUD Final Report, 28 Sep. 1978 - 28 Sep. 1979
C. H. Gay Wright-Patterson AFB, Ohio AFAPL Nov. 1979 149 p refs
(Contract F33615-78-C-2071; AF Proj. 3066)
(AD-A082754; AFAPL-TR-79-2108) Avail: NTIS HC A07/MF A01 CSCL 21/5

The Thermal Response Turbine Shroud program studied and evaluated overall engine active clearance control designs and payoffs for a broad range of engine/aircraft combinations. Both turbine and compressor active clearance control systems were considered for gas turbine engines that encompassed high and low fan bypass ratios, single and two stage turbines, and

commercial and military missions. The study of active clearance control included detailed material, heat transfer and thermal and mechanical growth analyses. The study effort looked at the active control of clearance at transient as well as steady state engine operation. The evaluation included an overall assessment of active clearance control benefits and penalties in both performance and cost for the particular aircraft/engine system studied. GRA

N80-24321# Systems Research Labs., Inc., Dayton, Ohio. Research Applications Div.
MATERIAL EVALUATION. PART 1: MECHANICAL PROPERTY TESTING AND MATERIALS EVALUATION AND MODELING Final Report, Apr. 1978 - Jun. 1979
Noel E. Ashbaugh Wright-Patterson AFB, Ohio AFML Sep. 1979 91 p refs
(Contract F33615-76-C-5191; AF Proj. 7351)
(AD-A081871; SRL-6909-01; AFML-TR-79-4127-Pt-1) Avail: NTIS HC A05/MF A01 CSCL 21/5

To accomplish the assessment of the characteristics of materials which are currently being used or which may be used in airframes and in gas-turbine engines, the following three tasks were performed--development and implementation of mechanical test methods, research on the application of solid mechanics to failure prediction, and investigation of environmental effects upon mechanical behavior. Some of the test methods which were developed in the first task were a low-cycle-fatigue (LCF) test capability, an experimental set-up to evaluate crack growth under sustained load, and a capability to conduct crack-growth tests under spectrum loads. In these tests the temperature range was normally between 538 C (1000 F) and 760 C (1400 F), and the specimen geometries were uniform gage specimens for the LCF tests, compact-type (CT) specimens for the sustained-load crack-growth tests, and CT and wedge-opening-loaded (WOL) specimens for crack-growth tests under spectrum loads. The tests which were conducted on material behavior provided data for at least 30 reports and journal articles. These tests, in addition to the previously developed tests, included uniaxial tension and compression tests, creep tests, fatigue-life tests, and single and multiple overload and underload tests. The temperature range for these tests was between room temperature and 760 C (1400 F). Equipment and instrumentation which were designed and fabricated for these tests included resistant furnaces, induction coils, dc conditioners, and power controllers. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N80-24322*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
AN ANALYTICAL STUDY OF EFFECTS ON AEROELASTICITY ON CONTROL EFFECTIVENESS Final Report, Jun. 1974 - Mar. 1980
Sudhir C. Mehrotra Mar. 1980 14 p refs
(Grant NsG-1046)
(NASA-CR-163197) Avail: NTIS HC A02/MF A01 CSCL 01C

Various uses of the Elastic Stability Derivative (ELASRAD) program are described. Topics include structural influence coefficient matrices of wings, arrow wing structural analysis, and graphic display of wing structures. The rigid and elastic stability derivatives were calculated for Transonic Aircraft Technology Project aircraft. E.D.K.

N80-24323*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MAXIMUM LIKELIHOOD METHOD FOR ESTIMATING AIRPLANE STABILITY AND CONTROL PARAMETERS FROM FLIGHT DATA IN FREQUENCY DOMAIN
Vladislav Klein May 1980 60 p refs Prepared in cooperation with Joint Institutes for Advancement of Flight Sciences, Hampton, Va.
(NASA-TP-1637; L-13383) Avail: NTIS HC A04/MF A01 CSCL 01C

A frequency domain maximum likelihood method is developed for the estimation of airplane stability and control parameters from measured data. The model of an airplane is represented by a discrete-type steady state Kalman filter with time variables replaced by their Fourier series expansions. The likelihood function of innovations is formulated, and by its maximization with respect to unknown parameters the estimation algorithm is obtained. This algorithm is then simplified to the output error estimation method with the data in the form of transformed time histories, frequency response curves, or spectral and cross-spectral densities. The development is followed by a discussion on the equivalence of the cost function in the time and frequency domains, and on advantages and disadvantages of the frequency domain approach. The algorithm developed is applied in four examples to the estimation of longitudinal parameters of a general aviation airplane using computer generated and measured data in turbulent and still air. The cost functions in the time and frequency domains are shown to be equivalent; therefore, both approaches are complementary and not contradictory. Despite some computational advantages of parameter estimation in the frequency domain, this approach is limited to linear equations of motion with constant coefficients. Author

N80-24324*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLUTTER ANALYSIS OF AN AIRPLANE WITH MULTIPLE STRUCTURAL NONLINEARITIES IN THE CONTROL SYSTEM
Elmar J. Breitbach Mar. 1980 39 p refs
(NASA-TP-1620; L-13356) Avail: NTIS HC A03/MF A01 CSCL 01C

Experience has shown that the flutter prediction process for airplanes can be greatly affected by strong concentrated nonlinearities which may be localized in the linking elements of the control mechanism, in the pivot joints of variable-sweep-wing systems, and in the connecting points between wing and pylon-mounted external stores. The principle of equivalent linearization offers an efficent possibility for solving the related nonlinear flutter equations in the frequency domain as a complement to the well-known time domain procedures. Taking as an example an airplane with nonlinear control characteristics, it is demonstrated how the equivalent linearization approach can be extended to rather complicated systems with multiple sets of strongly interacting, concentrated nonlinearities. Author

N80-24325# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
INITIAL DEVELOPMENT FOR A FLUTTER ANALYSIS OF DAMAGED T-38 HORIZONTAL STABILATORS USING NASTRAN M.S. Thesis
John O. Lassiter Mar. 1980 125 p refs
(AD-A082168; AFIT/GAE/AA/80M-2) Avail: NTIS HC A06/MF A01 CSCL 20/4

This thesis demonstrates the development and response of a finite element model of the T-38 horizontal stabilator using NASTRAN. The finite element model is to be used in a flutter analysis of damaged or repaired stabilators. The objective of the flutter analysis is to determine absolute values and degradations of the flutter speed due to different types of damages and repairs. Development of a finite element model with two dimensional quadrilateral and bar elements is described. For verification, a static analysis of the finite element model yielded for the most part qualitatively agreeable values in comparison to an influence coefficient study. For showing the dynamic response of the finite element model, a model analysis using both rigid and flexible root boundary conditions is used. The rigid root analysis shows agreement between the first two modes and the flexible root compares favorably up to three and possibly four modes. With these results, it is decided to use the finite element model in an initial flutter analysis. In the flutter analysis a doublet lattice aerodynamic model is combined with the finite element model for an undamaged stabilator. Poor agreement of the NASTRAN flutter speed with other available data indicates possible camber effects and the need for a verification aerodynamic model using steady and unsteady airloads. A brief description of a method

of simulating repairs and damages of a horizontal stabilator is included. GRA

N80-24326# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Applied Mathematics.
RESEARCH IN ADVANCED FLIGHT CONTROL DESIGN Final Scientific Report, 1 Jun. 1977 - 31 May 1979
Isaac Horowitz, B. Golurev, T. Kopelman, and S. Britman Jan. 1980 125 p refs
(Grant AF-AFOSR-3355-77; AF Proj. 2307)
(AD-A082424; AFFDL-TR-79-3120) Avail: NTIS HC A06/MF A01 CSCL 01/3

The flight control problem is one of regulation and control of a nonlinear, highly uncertain multiple input-output system, to achieve desired performance bounds. Feedback control theory has not been able to cope with even its approximate linear time-invariant version, because of its neglect of synthesis techniques in which uncertainty and performance bounds appear quantitatively. However, there have been two recent breakthroughs, giving precise, rigorous, quantitative synthesis techniques for both linear and nonlinear time-varying, single and multiple input-output systems containing plants with large uncertainties. In these techniques, quantitative performance bounds can be assigned in the time and/or frequency domain. For a large problem class, it is guaranteed that the design satisfies the specifications over the entire range of plant uncertainty. One of the breakthroughs was applied to a significantly nonlinear model of the short-period, longitudinal flight control problem. Uncertainty was included in the model by allowing for a large range in velocity and air-density, without any provision for their measurement. The output $c^*(t)$, was to lie within specified bounds in response to a range of step commands. The design was simulated with excellent results. GRA

N80-24327# Rockwell International Corp., Columbus, Ohio. North American Aircraft Div.
FLIGHT VERIFICATION OF DIRECT DIGITAL DRIVE FOR AN ADVANCED FLIGHT CONTROL ACTUATION SYSTEM (AFCAS) IN THE T-2C AIRCRAFT Final Report, Oct. 1978 - Nov. 1979
Lloyd K. Kohnhorst and Domenic A. Magnacca Nov. 1979 143 p refs
(Contract N62269-76-C-0201)
(AD-A081925; NR79H-97; NAVAIRDEVCEN-78207-60) Avail: NTIS HC A07/MF A01 CSCL 01/4

The feasibility of Direct Digital Drive for an Advanced Flight Control Actuation System (AFCAS) was successfully demonstrated in a T-2C aircraft. The test installation contained a digitally-controlled direct-drive rudder actuator, microcomputer, electronic drive unit, force transducers, and a localized 8000 PSI (55 MPa) hydraulic power supply. The system met all laboratory and flight test objectives and demonstrated direct microcomputer control of primary flight control surfaces. This program has demonstrated an approach that will improve performance and reliability of fly-by-wire control systems by reducing the system complexity. GRA

N80-24328# Bihrle Applied Research, Inc., Jericho, N. Y.
INFLUENCE OF PITCHING MOMENT CHARACTERISTICS ON DEPARTURE AND UNCOORDINATED ROLL REVERSAL BOUNDARIES FOR FIGHTER CONFIGURATIONS Final Report, May 1978 - Jun. 1979
William Birhle, Jr. Wright-Patterson AFB, Ohio AFFDL Feb. 1980 130 p refs
(Contract F33615-78-C-3600; AF Proj. 2403)
(AD-A082335; AFFDL-TR-79-3157) Avail: NTIS HC A07/MF A01 CSCL 01/3

A study is reported which generated design charts and developed associated boundaries for identifying departure and uncoordinated roll-reversal flight characteristics as a function of aerodynamic rolling and yawing moment coefficients typical of fighter airplanes for various pitching moment characteristics. This information should be valuable for specification, design and evaluation purposes. The investigation utilized a large angle, six-degree-of-freedom digital computer program to simulate the motions of a fighter performing a severe air combat maneuver. The results showed that the developed uncoordinated roll reversal boundaries may be applied to any fighter configuration and that the developed departure boundaries are applicable to fighter configurations exhibiting static pitch stability. Unaugmented airframes having pitch instability impose more stringent requirements on the rolling and yawing moment coefficients to avoid departure susceptibility. A simple angle-of-attack feedback augmentation system can markedly improve the departure resistance of both stable and unstable airframes given sufficient control authority. GRA

N80-24329# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
FLIGHT EVALUATION OF NONDIMENSIONAL STATIC LONGITUDINAL STABILITY TEST METHODS Final Report, Nov. 1974 - Feb. 1976
Kenneth R. Ferrell, Barclay H. Boirun, and James E. Jenks, Jr. Jul. 1979 66 p refs
(AD-A082831; USAAEFA-74-87) Avail: NTIS HC A04/MF A01 CSCL 20/4

Stability and control testing of helicopters at this activity has included performing discrete tests at representative mission conditions, as well as extremes of altitude, airspeed, vertical speed, rotor speed, gross weight, and center of gravity location. Special studies and tests concluded that the use of nondimensional parameters commonly used in performance analysis such as the thrust coefficient, advance ratio, and advancing tip Mach number could be used to reduce the number of independent test variables in stability and control testing. These studies also indicated that constant referred rotor speed might be better for isolation of compressibility effects than the conventional constant rotor speed method for obtaining nondimensional test data. This test investigated the relative advantage of obtaining static longitudinal stability and trim control data as a function of the nondimensional parameters using both the constant referred and constant rotor speed methods on a UH-1M helicopter. Within the accuracy of the test instrumentation, the static longitudinal trim control position data were found to be a function of thrust coefficient and advance ratio. The collective fixed static longitudinal stability was primarily a function of advance ratio only. The advancing tip Mach number did not have a significant effect on the longitudinal stability data on this test helicopter. Static longitudinal stability and control trim position can be defined by obtaining data over the full range of the thrust coefficient and advance ratio envelope and then using the nondimensional method to calculate intermediate value. GRA

N80-24330# Sandia Labs., Albuquerque, N. Mex. Exploratory Systems Div.
ROLL CONTROL OF AN ATTITUDE-CONTROLLED AERODYNAMIC VEHICLE WHICH HAS STRONG ROLL-YAW COUPLING
Farrell J. Perdreauville Oct. 1979 41 p
(Contract EY-76-C-04-0789)
(SAND-79-1940) Avail: NTIS HC A03/MF A01

Plant equations, autopilot structure and control philosophy are described for the roll control of a vehicle that has destabilizing roll-yaw coupling. Computer-implemented stability analyses and transient responses for two autopilot designs are presented and discussed. DOE

N80-24331# Royal Aircraft Establishment, Farnborough (England).
WIND TUNNEL/FLIGHT COMPARISON OF THE LEVELS OF BUFFETING RESPONSE INTENSITY FOR THE TACT F-111
G. F. Butler and G. R. Spavins London HMSO May 1979 28 p refs Presented at USAF/NASA Symp. on Transonic Aircraft Technol. Lancaster, Calif., Aug. 1978
(RAE-TM-Aero-1806; BR69201) Avail: NTIS HC A03/MF A01

A wind-tunnel/flight correlation has been made of the levels of buffeting response intensity of the TACT F-111 aircraft. Wind-tunnel measurements of the buffeting response of a 1/8 scale half-model of conventional construction have been used to predict the response of the TACT aircraft under full-scale flight conditions. Comparison with flight measurements shows good agreement. Author (ESA)

N80-24332# Royal Aircraft Establishment, Farnborough (England).

THE DESIGN OF AIRCRAFT AUTOMATIC RIDE-SMOOTHING SYSTEMS USING DIRECT-LIFT CONTROL
D. E. Fry and J. S. Winter London HMSO May 1979 93 p refs
(RAE-TR-79045; RAE-FS-98; BR70063) Avail: NTIS HC A05/MF A01

How a direct-lift motivator can be used to alleviate the response to vertical turbulence of a rigid, combat-type aircraft is shown. Optimal-control and parameter-optimization techniques are used to design both 'open' and 'closed' loop control systems. Alternative criteria other than simply reducing the normal acceleration response are discussed. The effects of system nonlinearities such as position and rate limits are explored. Both discrete and continuous models of turbulence are used in the analysis. Some nonlinear control solutions are discussed.
Author (ESA)

N80-24333# Royal Aircraft Establishment, Farnborough (England).
ON THE USE IN STABILITY ANALYSIS OF THE RELATIONSHIPS BETWEEN THE COEFFICIENTS OF A QUARTIC EQUATION AND THOSE OF QUADRATIC FACTOR
H. H. B. M. Thomas London HMSO Jun. 1979 63 p refs
(RAE-TR-79065; RAE-Aero-3456; BR70237) Avail: NTIS HC A04/MF A01

The stability of the perturbed longitudinal motion of an unaugmented aircraft about a given trimmed flight condition was determined by the well-known stability quartic. It is shown that two basic relationship exist between the coefficients of the quartic and those of a quadratic factor. Results show that examination of the position of the locus traced out by the point defined by the coefficients of the quadratic in relation to the axes and the parabolic boundary (separating real and complex roots) enables the trends in the nature of and the degree of stability of the mode or modes represented by the quadratic factor to be determined. Expressions are given which enable the value of the parameter being varied, and associated with a given point of the locus, to be calculated. The use of this method of analyzing aircraft stability is illustrated by a number of examples.
Author (ESA)

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

N80-24334*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
METRIC HALF-SPAN MODEL SUPPORT SYSTEM Patent Application
Charlie M. Jackson, Jr., Samuel M. Dollyhigh, and David S. Shaw, inventors (to NASA) Filed 30 Apr. 1980 11 p
(NASA-Case-LAR-12441-1; US-Patent-Appl-SN-145210) Avail: NTIS HC A02/MF A01 CSCL 01E

A model support system used to support a model in a wind tunnel test section is described. The model comprises a metric, or measured, half-span supported by a nonmetric, or nonmeasured, half-span which is connected to a sting support. Moments and forces acting on the metric half-span are measured without interference from the support system during a wind tunnel test.
NASA

N80-24335# Pennsylvania Transportation Inst., University Park.
ACCEPTANCE CRITERIA FOR BITUMINOUS SURFACE COURSE ON CIVIL AIRPORT PAVEMENTS Final Report
J. L. Burati and J. H. Willenbrock Oct. 1979 196 p refs
(Contract DOT-FA78WA-4185)
(AD-A080430; PTI-7915; FAA-RD-79-89) Avail: NTIS HC A09/MF A01 CSCL 01/5

The development of a statistically based price adjustment acceptance plan for a bituminous surface course is discussed. Data on the physical characteristics of pavement materials were collected from thirteen airport pavement construction projects. A statistical analysis of this data permitted the determination of the parameters (mean and standard deviation) on existing airport construction projects, and these parameters were then used to develop acceptance plans and price adjustment factors. Operating Characteristics (OC) curves and curves of expected payment were used to determine the appropriate acceptance plans, which were based on the percentage of material falling within specification limits (PWL). By using a continuous rather than a discrete price adjustment schedule, it was possible to avoid the problem of large differences in payment associated with relatively small differences in quality (as measured by PWL). A computer program was developed to approximate the expected payment curves associated with different continuous price adjustment systems. This program is applicable to one-sided specification limits such as density. For properties such as air voids, which require both an upper and lower specification limit, the OC curves were determined by computer simulation of 10,000 randomly drawn samples
M.G.

N80-24336# General Accounting Office, Washington, D. C. Logistics and Communications Div.
INCREASED STANDARDIZATION WOULD REDUCE COSTS OF GROUND SUPPORT EQUIPMENT FOR MILITARY AIRCRAFT
7 Feb. 1980 65 p
(PB80-139546; LCD-80-30) Avail: NTIS HC A04/MF A01 CSCL 05A

An analysis of ground support equipment standardization is presented. Substantial savings could be realized if military aircraft ground support equipment could service more than one aircraft. It is suggested that the Department of Defense needs to emphasize standardization of this equipment and improve systems for reducing duplication of equipment. The Department should seek to provide incentives to contractors to use existing aircraft support equipment in the design of new weapon systems.
GRA

N80-24337# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Environmental Control Branch.
A COMBINED ENVIRONMENTS RELIABILITY TEST (CERT) FACILITY FOR TESTING OF AIRBORNE EQUIPMENT Final Report, Jun. 1976 - Oct. 1978
Harriman E. Reynolds Sep. 1979 32 p refs
(AF Proj. 2402)
(AD-A080974; AFFDL-TR-79-3079) Avail: NTIS HC A03/MF A01 CSCL 01/3

A third combined environment reliability test facility has been developed with improved capability to simulate the dynamic combined environments that internally carried aircraft equipment is exposed to in modern high performance military aircraft. An electro-pneumatic control system individually controls compartment temperature, humidity, air mass flow and altitude, and equipment cooling air temperature, humidity, and mass flow from a tape deck according to aircraft ground and flight profiles programmed on magnetic tape. Random mechanical vibration control is semi-automatic. The design, engineering development, and partial performance capabilities are documented.
GRA

N80-24338# New Mexico Univ., Albuquerque. Civil Engineering Research Facility.
PREDICTING THE FATIGUE LIFE OF FLEXIBLE AIRFIELD PAVEMENTS: A RECOMMENDED APPROACH Final Report, Jul. 1978 - Jun. 1979
Dale S. Decker Tyndall AFB, Fla. AFESC Jul. 1979 123 p refs
(Contract F29601-76-C-0015; AF Proj. 2104)
(AD-A079747; AFESC/ESL-TR-79-26) Avail: NTIS HC A06/MF A01 CSCL 01/5

The pavement engineer currently has no realistic means of predicting the fatigue life of an existing asphalt pavement or the service of a new asphalt pavement surface. The development of information that would enable engineers to make realistic fatigue life predictions, and thereby to make the best use of the increasingly scarce pavement maintenance dollar, is critically needed. This report reviews current fatigue and routine design

test methods and examines the effects of materials and environmental conditions on fatigue life. The extensive literature review indicates a possibility that fatigue life may be estimated by correlating known fatigue parameters with results of routine design tests. The repeated-load indirect tensile (fatigue) test and the resilient modulus indirect tensile (routine design) test are recommended for use in U.S. Air Force investigations. GRA

N80-24339# Defence Research Information Centre, Orpington (England).
THE FRICTION CLASSIFICATION OF RUNWAYS
R. W. Sugg (Mech. Eng. Res. and Develop.), I. Beaty (Cranfield Inst. of Tech.), and R. J. Nicholls (Cranfield Inst. of Tech.) London HMSO Dec. 1979 43 p refs
(S/T-Memo-6-79; BR70258) Avail: NTIS HC A03/MF A01

With the development of the continuous recording runway friction meter (Mu-Meter) and a runway self wetting system contained in the tow vehicle, it is possible to obtain a permanent record showing the friction reading along the entire length of a runway. The method developed to carry out such a trial together with its associated Standard Friction Classification Table is described. Use of the Mu-Meter under natural rain conditions demonstrates that aircraft aquaplaning can sometimes occur in local areas. A method for identifying these areas is explained and how results can be combined with the self wetting trial to give a proper friction evaluation of a runway is shown. The relationship in Mu-Meter readings to the US Federal Aviation Administration and UK Ministry of Defence methods runway friction classification is determined and reported. Author (ESA)

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N80-24679*# Aerospace Corp., Los Angeles, Calif.
USER REQUIREMENTS OF SOLAR-TERRESTRIAL PREDICTIONS FOR SPACECRAFT APPLICATIONS
A. L. Vampola, R. Altrock, W. Atwell, R. C. Backstrom, H. B. Garrett, David R. Hickman, R. G. Johnson, N. H. Pereyaslova, D. Robbins, and J. Slowey *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 1-20 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 22A

N80-24683*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR-INDUCED VARIATIONS OF ENVIRONMENT AFFECTING MANNED SPACE FLIGHT AND SPACECRAFT OPERATIONS
William G. Johnson, Thomas A. Parnell, and William W. Vaughan *In its* Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 89-103 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 22A

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N80-24340# Aerospace Defense Command, Peterson AFB, Colo. Office of Astrodynamics.
A RESTRICTED FOUR BODY SOLUTION FOR RESONATING SATELLITES WITHOUT DRAG
Richard S. Hujsak Nov. 1979 72 p refs
(AD-A081263; Astrodynamic-1) Avail: NTIS HC A04/MF A01 CSCL 03/3

A generalized method of averaging is used to study two general problems for drag free motion of an artificial Earth satellite. The first development includes perturbations due to the point masses of the Earth, Moon and Sun as well as zonal variations. The second development extends the first to include tesseral and sectoral harmonics as resonance perturbations for two specific classes of orbits. GRA

N80-24341# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
DRAG ESTIMATION AND SATELLITE ORBIT DETERMINATION
A. Eisner Mar. 1980 45 p refs
(Contract N00024-78-C-5384)
(AD-A082888; JHU/APL/TG-1327) Avail: NTIS HC A03/MF A01 CSCL 22/3

Like the weather, upper atmospheric density often behaves unpredictably. Even the best models of the upper atmosphere cannot consistently predict atmospheric density for Transit System satellites (1000 km) to the desired high precision. A comprehensive evaluation is presented of the drag estimation concept as a tool in routinely determining the orbit of the Transit System; the benefits to the Transit System are also examined. The resulting data (fitted along-track bias force) can be used subsequently to study upper atmospheric density variations at Transit satellite altitudes that will lead ultimately to improved upper atmospheric density models. Drag estimation in satellite orbit determination yields higher precision-tracked (determined) ephemerides and significantly improves the prediction (extrapolated satellite position) accuracy of the Transit System. GRA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

N80-24342*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BIOCENTRIFUGE SYSTEM CAPABLE OF EXCHANGING SPECIMEN CAGES WHILE IN OPERATIONAL MODE Patent Application
Robert R. Belew, inventor (to NASA) Filed 30 Apr. 1980 20 p
(NASA-Case-MFS-23825-1; US-Patent-APPL-SN-145273)
Avail: NTIS HC A02/MF A01 CSCL 06B

A bioresearch centrifuge system for subjecting caged animals to long term centrifugal forces that create gravity conditions aboard orbiting spacecraft is disclosed. The biocentrifuge system is comprised of a centrifuge carrying a plurality of removable and replaceable cages for the animal specimens. Pairs of opposing cages may be removed from the frame while it is rotating, by means of a cage exchanger which rotates concentrically within the centrifuge and the speed of which is controlled independently of the frame speed. An image rotator is provided for selective observation of the rotating animals. The system further includes a waste conveyor system, a food supply system, and a water supply system for each cage for creating a life sustaining environment so that the animals can live in the rotating centrifuge for extended periods. The rotating cage exchanger can also be used to selectively remove containers from various other centrifuges or other rotatable frame structures. NASA

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N80-24343*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE OPERATIONS CENTER: A CONCEPT ANALYSIS
Louis E. Livingston 29 Nov. 1979 180 p
(NASA-TM-81062; JSC-16277) Avail: NTIS

HC A09/MF A01 CSCL 22B

The Space Operations Center is a concept for a shuttle-service, permanent, manned facility in low Earth orbit. An analysis of this concept was conducted and the results are reported. It is noted that there are no NASA plans at present to implement such a concept. The results are intended for consideration in future planning. J.M.S.

N80-24344*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

STUDY OF MULTI-kW SOLAR ARRAYS FOR EARTH ORBIT APPLICATION

30 Apr. 1980 334 p

(Contract NAS8-32981)

(NASA-CR-161453; LMSC-D715841) Avail: NTIS HC A14/MF A01 CSCL 22B

Low cost low Earth orbit (LOW) and geosynchronous Earth orbit (GEO) Solar Array concepts in the 300 to 1000 kW range which could be reduced to hardware in the mid 1980's, are identified. Size scaling factors and longer life demands are recognized as the prime drivers for the designs if low life cycle costs for energy are to be achieved. Technology is identified which requires further development in order to assure component readiness and availability. Use of the low concentration ratio (CR) concentrator, which uses gallium arsenide solar cells for both LEO and GEO applications, is recommended. E.D.K.

N80-24345*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

STUDY OF MULTI-kW SOLAR ARRAYS FOR EARTH ORBIT APPLICATION Progress Report, 15 Mar. 1979 - 1 Mar. 1980

21 Mar. 1980 202 p

(Contract NAS8-32981)

(NASA-CR-161452; LMSC-D715827) Avail: NTIS HC A10/MF A01 CSCL 22B

Planar and concentrator solar array configurations based on silicon and gallium arsenide solar cells were conceptualized and on-orbit maintainability was addressed. Four basic categories emerged: (1) planar (non concentrated) with silicon cells, (2) low-CR (concentration ratio = 3.4) with silicon cells, (3) low-CR with GaAs, and (4) high-CR (concentration ratio = 62.5) with GaAs. A very high-CR (concentration ratio = 200) was investigated but rejected on thermal grounds. Nonrecurring and recurring cost elements for each of the four concepts selected were compared over a 15 year life cycle. Under conditions where the gallium arsenide cells can be produced for less than $25 per 2 x 2 cm, the low CR concentrator emerges as the most cost effective configuration. However, the producibility risk remains higher on the gallium arsenide cell. R.E.S.

N80-24346*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

VIKING MARS MISSION SUPPORT INVESTIGATIONS IN THE LANGLEY TRANSONIC DYNAMICS TUNNEL

Jerome T. Foughner, Jr. May 1980 23 p refs

(NASA-TM-80234; L-13405) Avail: NTIS HC A02/MF A01 CSCL 22A

Six experimental investigations conducted in the transonic dynamics tunnel, which supported elements of the entry and the landed phases of the Viking mission, are described. The objective of each investigation and selected experimental results are presented. How these particular wind tunnel results contributed to spacecraft development and ultimately to the success of the Viking mission is indicated. Experimental studies applicable to the entry phase of the mission included parachute environment and performance definition, aerodynamic characteristics exhibited by two separating bodies, and pressure measurements in the transonic range to optimize the location and orientation of a stagnation-pressure sensor on the Lander. The experimental investigations which supported the landed phase of the mission included a convective heat transfer test to establish the requirements for wind covers for the radioisotope thermoelectric generators and two tests which supported the development and calibration of the meteorological science experiment. M.G.

N80-24347# Lincoln Lab., Mass. Inst. of Tech., Lexington.

GEODSS ORBIT DISPLAY PROGRAM (GEOD)

Andrew J. Wardrop 19 Nov. 1979 28 p

(Contract F19628-80-C-0002; AF Proj. 2128; AF Proj. 2295) (AD-A081498; ETS-1; ESD-TR-79-270) Avail: NTIS HC A03/MF A01 CSCL 22/3

An interactive computer program has been developed for plotting world maps, satellite ground tracks, and orbit coverage by a system of ground sensors. All plotting is done by an HP7221A four color pen plotter attached to the MODCOMP IV. This report is a users manual for this program, and contains several examples of plots. GRA

N80-24348# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Electrical Engineering.

OPTICAL PATTERN RECOGNITION FOR MISSILE GUIDANCE Final Report, 1 Oct. 1978 - 30 Sep. 1979

David Casasent 1 Jan. 1979 80 p refs

(Grant AF-AFOSR-2851-75; AF Proj. 2305)

(AD-A082134; AFOSR-80-0158TR) Avail: NTIS HC A05/MF A01 CSCL 17/7

Research on optical pattern recognition (OPR) for missile guidance has addressed three general areas: new OPR techniques, OPR experiments on specific missile guidance problems and scenarios, and component evalustion and testing. In the area of component evaluation and testing, research has been concentrated on 2-D spatial light modulators (SLM) with specific attention to the photo-DKDP, prom, and the liquid crystal light valve and to a general test and evaluation procedure for these devices. A general SLM test and evaluation procedure has been developed. In the area of new OPR techniques, a coherence measure correlator, an equalization correlator, moment invariant hybrid correlator and an averaged filter correlator have been developed. Specific missile guidance scenarios persued were OPR of multi-sensor and infrared imagery. The former has laid initial ground work for a future program in optical statistical and deterministic pattern recognition. The latter has initiated a generalized approach to OPR using hyperspace formulations and linear combinations of orthonormal basis functions. GRA

N80-24349# Ohio State Univ., Columbus.

ACCURACY ESTIMATES OF 1 DEG X 1 DEG MEAN ANOMALY DETERMINATIONS FROM A HIGHLOW SST MISSION Interim Report

Richard H. Rapp and D. P. Hajela Hanscom AFB, Mass. AFGL Sep. 1979 18 p refs

(Contract F19628-79-C-0027; AF Proj. 2309)

(AD-A083035; DGS-295; AFGL-TR-79-0269; SR-3) Avail: NTIS HC A02/MF A01 CSCL 08/5

The method of least squares collocation is used to estimate the accuracy and correlation of 1 degree x 1 degree anomalies that could be determined from a high-low satellite to satellite tracking mission. The observed data is taken to be the line of sight acceleration which can be computed from the range rate data. Variables considered in this study were: (a) the spherical distance from the center of the 1 degree x 1 degree block within which data is selected for use; (b) the accuracy of the 'observed' accelerations; (c) the height of the low satellite; and (d) the data density or interval. Typical results indicate that a low satellite height of 200 km, a data noise corresponding to a range accuracy of + or - 0.015 cm/sec, would yield a 1 degree x 1 degree anomaly to an accuracy of about + or - 8 mgals with an average error correlation coefficient between adjacent blocks of -0.6. Lowering the satellite to 150 km reduces the accuracy to about + or - 5 mgals but increases the correlaton to about -0.9. This study does not consider the effects of orbit error, nor errors in the degree 12 reference field. In addition, some results could not be obtained when stable matrix inversions could not be obtained. This occured when dense data and/or low data noise was being used. GRA

N80-24350# Wentworth Inst., Boston, Mass.

PAYLOAD INSTRUMENTATION FOR PROBING ROCKETS Final Report, Apr. - Mar. 1979

R. W. Ebacher Hanscom AFB, Mass. AFGL Dec. 1979 17 p

(Contract F19628-76-C-0211; AF Proj. 7659)

(AD-A083023; AFGL-TR-80-0027) Avail: NTIS HC A02/MF A01 CSCL 03/2

Personnel, facilities, services and materials were provided

for the design, development, fabrication, assembly, installation and testing of electro-mechanical instrumentation comprising the payloads utilized in aerospace vehicles as a part of the upper atmosphere and astronomical research program being conducted by the U.S. Air Force. Special devices such as a field programmable digital timer and low cost vibration recorder suitable for general use in sounding rocketborne sensing payloads were developed. Also developed was a control system to focus a cryogenically cooled infrared sensing instrument on a particular star. This contract also entailed the design, fabrication, assembly and testing of instruments for the remote operation and monitoring of the rocketborne apparatus from a blockhouse along with recovery and retesting of certain instruments. Provision was made for the preparation and reproduction of all necessary mechanical detail and assembly drawings and circuitry schematics, as well as for participation in the pre-flight, flight and post-flight field operations associated with the assembly, preparation and launching of the probing vehicles at the various launch sites selected by the Air Force Geophysics Laboratory for the conducting of rocket-borne experiments. GRA

N80-24351# Royal Aircraft Establishment, Farnborough (England).
SECOND-ORDER PERTURBATIONS DUE TO J2 FOR A LOW-ECCENTRICITY EARTH-SATELLITE ORBIT
R. H. Gooding London ESA Aug. 1979 74 p refs
(RAE-TR-79100; RAE-Space-566; BR71411) Avail: NTIS HC A04/MF A01

The perturbations of order J (2) sub 2 in the orbital elements of an Earth satellite are analyzed by an elementary treatment that neglects terms of order J (2) sub 2 e. The resulting expressions are combined into a triad of cylindrical polar coordinates, defined by a plane of fixed inclination and uniform rotation rate. Mean orbital elements are required and are introduced in a general manner involving arbitrary constants. Both first order and second order perturbation formulas are made as compact as possible for the cylindrical coordinates. The second order results are expressed in terms of the Earth's equatorial radius, the satellite's mean semimajor axis, its inclination, and its argument of latitude. Other aspects of the J sub Z main problem are also considered. Author (ESA)

N80-24352# General Accounting Office, Washington, D. C. Procurement and Systems Acquisition Div.
NAVSTAR SHOULD IMPROVE THE EFFECTIVENESS OF MILITARY MISSIONS: COST HAS INCREASED Report to the Congress
15 Feb. 1980 31 p
(PSAD-80-143126; PSAD-80-21) Avail: NTIS HC A03/MF A01 CSCL 22B

The program, which is being developed for precise worldwide navigation and position capability, has increased in cost from about $1.7 billion to $8.6 billion. This is due largely to estimates not previously included for replenishment satellites, launches, and user equipment. Extensive testing proved that NAVSTAR may provide accurate navigation and position information. However, its potential problems relating primarily to Soviet threat, satellite reliability, and launch capability could have serious cost schedule or performance implications. GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N80-24353*# Little (Arthur D.), Inc., Cambridge, Mass.
SPACE TRANSPORTATION SYSTEM THERMAL ENVIRONMENTAL FLUX REFERENCE BOOK
Oct. 1979 466 p
(NASA Order C-79393-07)
(NASA-CR-159968) Avail: NTIS HC A20/MF A01 CSCL 22B

The information necessary to estimate the thermal environment in which proposed instruments will be expected to operate is presented in curves and tables which indicate the magnitude of the environmental fluxes which can be expected for various space transportation system missions. A.R.H.

N80-24354*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A DESIGN ASSESSMENT OF MULTIWALL, METALLIC STAND-OFF, AND RSI REUSABLE THERMAL PROTECTION SYSTEMS INCLUDING SPACE SHUTTLE APPLICATION
L. Robert Jackson and Sidney C. Dixon Apr. 1980 96 p refs
(NASA-TM-81780) Avail: NTIS HC A05/MF A01 CSCL 22B

The design and assessment of reusable surface insulation (RSI), metallic stand off and multiwall thermal protection systems (TPS) is discussed. Multiwall TPS is described in some detail, and analyses useful for design of multiwall are included. Results indicate that multiwall has the potential to satisy the TPS design goals better than the other systems. The total mass of the stand-off TPS and of the metallic systems require less primary structure mass than the RSI system, since the nonbuckling skin criteria required for RSI may be removed. Continued development of multiwall TPS is required to verify its potential and to provide the necessary data base for design. M.G.

N80-24355*# Northrop Services, Inc., Huntsville, Ala.
IUS GUIDANCE ALGORITHM GAMMA GUIDE ASSESSMENT
R. E. Bray and V. A. Dauro Apr. 1980 54 p refs
(Contract NAS8-33197)
(NASA-CR-161448; TR-230-1995) Avail: NTIS HC A04/MF A01 CSCL 22B

The Gamma Guidance Algorithm which controls the inertial upper stage is described. The results of an independent assessment of the algorithm's performance in satisfying the NASA missions' targeting objectives are presented. The results of a launch window analysis for a Galileo mission, and suggested improvements are included. J.M.S.

N80-24356*# ARO, Inc., Arnold Air Force Station, Tenn.
AEROTHERMAL TESTS OF THE THERMAL PROTECTION SYSTEM MATERIALS FOR THE SPACE SHUTTLE SOLID ROCKET BOOSTERS AND SOLID ROCKET MOTORS Final Report, 17 Jan. - 2 Apr. 1979
John O. Ievalts May 1979 45 p refs Sponsored by NASA
(NASA-CR-163157; AD-A081970; AEDC-TSR-79-V27) Avail: NTIS HC A03/MF A01 CSCL 21/9

Samples of insulation materials under consideration for use on the various protuberances of the Space Shuttle Solid Rocket Boosters and Solid Rocket Motors were tested to evaluate their survivability at simulated flight heating levels. Heat transfer calibration data were obtained by the use of the thin-skin technique on several protuberance configurations. All tests were conducted in the VKF Tunnel C. GRA

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

N80-24357*# Texas Technological Univ., Lubbock. Biomedical Systems Lab.
A MINIATURIZED DIGITAL TELEMETRY SYSTEM FOR PHYSIOLOGICAL DATA TRANSMISSION
William M. Portnoy and Larry J. Stotts 31 Mar. 1978 56 p refs
(Contract NAS9-11162)
(NASA-CR-160660) Avail: NTIS HC A04/MF A01 CSCL 09F

A physiological date telemetry system, consisting basically of a portable unit and a ground base station was designed,

built, and tested. The portable unit to be worn by the subject is composed of a single crystal controlled transmitter with AM transmission of digital data and narrowband FM transmission of voice; a crystal controlled FM receiver; thirteen input channels followed by a PCM encoder (three of these channels are designed for ECG data); a calibration unit; and a transponder control system. The ground base station consists of a standard telemetry reciever, a decoder, and an FM transmitter for transmission of voice and transponder signals to the portable unit. The ground base station has complete control of power to all subsystems in the portable unit. The phase-locked loop circuit which is used to decode the data, remains in operation even when the signal from the portable unit is interrupted. A.R.H.

N80-24358# Air Force Geophysics Lab., Hanscom AFB, Mass. Aerospace Instrumentation Div.
TELEMETRY ANTENNAS FOR LARGE DIAMETER SOUNDING ROCKETS Instrumentation Papers, 1 Oct. 1977 - 31 Jan. 1979
Raymond E. Wilton and Alexander Waterman Sep. 1979 23 p refs
(AF Proj. 7659)
(AD-A082383; AFGL-TR-79-0205; AFGL-IP-280) Avail: NTIS HC A02/MF A01 CSCL 09/1

The telemetry antenna systems developed for use on large diameter research sounding rockets have been investigated and test flights have been conducted. Three antenna concepts were studied: a flush-mounted antenna system, a surface-mounted system, and a directional system for attitude-controlled vehicles. Several successful designs have been completed and are now standard with Air Force research payloads. GRA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

N80-24884*# Air Force Geophysics Lab., Hanscom AFB, Mass. Space Physics Div.
PREDICTION OF SPACECRAFT POTENTIALS AT GEOSYNCHRONOUS ORBIT
H. B. Garrett, A. G. Rubin, and C. P. Pike *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 104-118 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N80-24359# Air Force Geophysics Lab., Hanscom AFB, Mass.
CALIBRATION OF THE RAPID SCAN PARTICLE DETECTOR MOUNTED IN THE SCATHA SATELLITE Final Report
Frederick A. Hanser, David A. Hardy, and Bach Sellers 18 Jul. 1979 41 p refs
(AF Proj. 7661)
(AD-A082382; AFGL-TR-79-0167; AFGL-IP-278) Avail: NTIS HC A03/MF A01 CSCL 22/2

A rapid scan particle detector (RSPD) for electrons and protons in the range of 0.05 keV to greater than a few MeV has been designed, constructed, and calibrated. The RSPD uses electrostatic analyzers (ESA's) with Spiraltron electron multipliers (SEM's) for 0.05 to 60 keV particles, and solid-state detector telescopes for the higher energy particles. The ESA's have been extensively calibrated at the Rice University Calibration Facility, using 0.04 to 45 keV electrons and 0.1 to 30 keV ions, and the results are given in this report. The calibration procedure for the SSS's is also described, and the results are tabulated. The RSPD was launched in the SCATHA satellite on 30 January 1979 and is known as the SC5 instrument. Orbit operations have been excellent, with the SSS's operating nearly 100 percent of the time and the ESA's operating about 50 percent time operation at a higher bias level is achieving a sufficiently stable operation that should allow reliable data-taking for at least the one year design life. GRA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N80-24360*# Rocketdyne, Canoga Park, Calif.
ORBITAL TRANSFER VEHICLE (OTV) ENGINE STUDY. PHASE A: EXTENSION Bimonthly Progress Report
A. J. Sobin 11 Jan. 1980 22 p
(Contract NAS8-32996)
(NASA-CR-161374; ASRB0-80; BMR-3) Avail: NTIS HC A02/MF A01 CSCL 21H

The current Phase A-Extension of the OTV engine study program aims to provide additional expander and staged combustion cycle data that will lead to design definition of the OTV engine. The proposed program effort seeks to optimize the expander cycle engine concept (consistent with identified OTV engine requirements), investigate the feasibility of kitting the staged combustion cycle engine to provide extended thrust operation, and conduct in-depth analysis of development risk, crew safety, and reliability for both cycles. Additional tasks address the costing of a 10/K thrust expander cycle engine and support of OTV systems study contractors. A.R.H.

N80-24361*# Lockheed Missiles and Space Co., Huntsville, Ala.
SUMMARY OF SOLID ROCKET MOTOR PLUME FLOW FIELD AND RADIATION ANALYSES Final Report
Beverly J. Audeh, Robert E. Carter, and Sheldon D. Smith Apr. 1980 28 p refs
(Contract NAS8-28609)
(NASA-CR-161456; LMSC-HREC-TR-D697900) Avail: NTIS HC A03/MF A01 CSCL 21H

The inclusion of solid propellant plume flow field effects in analyses and design of the space vehicle was investigated. Results of these analyses are summarized. J.M.S.

N80-24362*# Colorado State Univ., Fort Collins. Dept. Of Mechanical Engineering.
INERT GAS THRUSTERS Annual Report
Harold R. Kaufman and Raymond S. Robinson Nov. 1979 113 p refs
(Grant NsG-3011)
(NASA-CR-159813) Avail: NTIS HC A06/MF A01 CSCL 21C

Inert gas thrusters considered for space propulsion systems were investigated. Electron diffusion across a magnetic field was examined utilizing a basic model. The production of doubly charged ions was correlated using only overall performance parameters. The use of this correlation is therefore possible in the design stage of large gas thrusters, where detailed plasma properties are not available. Argon hollow cathode performance was investigated over a range of emission currents, with the positions of the inert, keeper, and anode varied. A general trend observed was that the maximum ratio of emission to flow rate increased at higher propellant flow rates. It was also found that an enclosed keeper enhances maximum cathode emission at high flow rates. The maximum cathode emission at a given flow rate was associated with a noisy high voltage mode. Although this

mode has some similarities to the plume mode found at low flows and emissions, it is encountered by being initially in the spot mode and increasing emission. A detailed analysis of large, inert-gas thruster performance was carried out. For maximum thruster efficiency, the optimum beam diameter increases from less than a meter at under 2000 sec specific impulse to several meters at 10,000 sec. The corresponding range in input power ranges from several kilowatts to megawatts. J.M.S.

N80-24363# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DETECTABILITY OF COLD ROCKET PLUMES
Gerald F. Dionne, Marvin M. Litvak, Jerald A. Weiss, and William D. Fitzgerald 11 Oct. 1979 63 p refs
(Contract F19628-80-C-0002; DA Proj. 8X3-63304-D-215)
(AD-A081858; TN-1979-48; ESD-TR-79-264) Avail: NTIS HC A04/MF A01 CSCL 21/2

The problem of detecting high altitude rocket plumes with satellite-borne submillimeter-wave radiometers is examined from both theoretical and experimental points of view. To estimate the sizes of plume signatures contrasted against a 250-K earth background or in self-emission against the cold sky, a computer program has been developed to predict plume brightness temperatures and optical depths of rotational lines of plume molecular constituents (e.g., H2O) as a function of distance from the nozzle. The methods employed in the computations are described in general terms, and examples are presented to indicate that detectable H2O signatures extending to several thousand nozzle diameters should exist at plume altitudes above 250 km. Details of a laboratory water vapor jet operating in a high vacuum environment designed to simulate a rocket plume at high altitude are outlined. Sensitivity considerations relevant to the plume detection problem are discussed for Fourier transform spectrometers and heterodyne receivers designed to study spectral lines in the submillimeter-wave region. Finally, a technique for converting the heterodyne radiometer into a spectrometer is described as a means of obtaining line shape details of the 752-GHz H2O line. GRA

N80-24364# Naval Air Development Center, Warminster, Pa.
ROCKET PLUME BURN HAZARD Final Report
A. M. Stoll, J. R. Piergallini, and M. A. Chinata 3 Jan. 1980 23 p refs
(WF51523000)
(AD-A081965; NADC-80008-60) Avail: NTIS HC A02/MF A01 CSCL 21/9

By use of miniature rocket engines, the burn hazard posed by exposure to ejection seat rocket plume flames was determined in the anaesthetized rat. A reference chart is provided for predicting equivalent effects in human skin based on extrapolation of earlier direct measurements of heat input for rat and human burns. The chart is intended to be used in conjunction with thermocouple temperature measurements of the plume environment for design and modification of escape seat systems to avoid thermal injury on ejection from multiplace aircraft. GRA

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N80-24365# National Bureau of Standards, Washington, D.C. National Engineering Lab.
AN INTERLABORATORY EVALUATION OF THE ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS) E84-77a TUNNEL TEST MODIFIED BY THE CONSUMER PRODUCT SAFETY COMMISSION FOR CELLULOSIC LOOSE FILL INSULATION Final Report
J. Randall Lawson Nov. 1979 37 p ref
(PB80-128317; NBSIR-79-1922) Avail: NTIS HC A03/MF A01 CSCL 13C

An interlaboratory evaluation was conducted to determine precision estimates for repeatability and reproducibility of the American Society for Testing and Materials (ASTM) E 84-77a tunnel test as modified by the Consumer Product Safety Commission for cellulosic loose fill insulation. Six laboratories participated by running tunnel tests on eight cellulosic loose fill materials. Each laboratory was surveyed during the project to examine its conformance with the critical details of the test apparatus and procedure. The results of the survey showed that none of the tunnels completely conformed with the specifications of the modified ASTM 84-77a standard. GRA

24 COMPOSITE MATERIALS

Includes laminates.

N80-24366 Washington Univ., Seattle.
DYNAMIC TORSIONAL BEHAVIOR OF SOME CARBON FIBERS Ph.D. Thesis
Seshadri Srinivasagopalan 1979 149 p
Avail: Univ. Microfilms Order No. 8013597

The torsional modulus G and damping infinity of carbon fibers were investigated using a double torsion pendulum operated in vacuum (2-4x 10 to the minus 5th power torr) at low frequencies (0.5 to 1.5 Hz). The dynamic torsion behavior was studied with respect to the heat treatment temperature, measurement temperature, applied tensile stress and static torsional bias strain for selected fibers made from pitch, rayon, poly-acrylo-nitrile, and pitch mesophase precursors. The intrinsic torsional moduli G sub zero (extrapolated to zero tensile stress) were found to range from 9 to 35 GPa and were correlated with variations in the microstructure. Dissert. Abstr.

N80-24367*# Lockheed-California Co., Burbank.
STUDY OF THE INFLUENCE OF HOLE QUALITY ON COMPOSITE MATERIALS
J. J. Pengra Feb. 1980 81 p refs
(Contract NAS1-15599)
(NASA-CR-159257) Avail: NTIS HC A05/MF A01 CSCL 11D

The influence of hole quality on the structural behavior of composite materials was investigated. From an industry survey it was determined that the most frequent imperfections encountered during hole fabrication are chipout, delamination, and oversize conditions. These hole flaw types were generated in critical areas of static, compression, and fatigue specimens fabricated from T300/5208 graphite/epoxy system. The specimens were tested in static and cyclic pin bearing modes in addition to compression loading. Results of these tests are presented and discussed. The hole chipout defect reduced the static and cyclic endurance characteristics. Oversize holes also lowered the cyclic pin bearing endurance, but had no influence of the static pin bearing characteristics. Delamination had no insignificant influence on the static tension and cyclic pin bearing characteristics. Compression tests demonstrated a deleterious effect for chipout of delamination defects. Hole quality requirements proposed are discussed. J.M.S.

N80-24368*# Michigan Univ., Ann Arbor.
MANUFACTURE OF FIBER-EPOXY TEST SPECIMENS: INCLUDING ASSOCIATED JIGS AND INSTRUMENTATION
S. B. Mathur and D. K. Felbeck May 1980 20 p
(Grant NGR-23-005-528)
(NASA-CR-163198) Avail: NTIS HC A02/MF A01 CSCL 11D

Experimental work on the manufacture and strength of graphite-epoxy composites is considered. The correct data and thus a true assessment of the strength properties based on a proper and scientifically modeled test specimen with engineered design, construction, and manufacture has led to claims of a very broad spread in optimized values. Such behavior is in the main due to inadequate control during manufacture of test specimen, improper curing, and uneven scatter in the fiber orientation. The graphite fibers are strong but brittle. Even with various epoxy matrices and volume fraction, the fracture toughness is still relatively low. Graphite-epoxy prepreg tape was investigated as a sandwich construction with intermittent interlaminar bonding between the laminates in order to produce high strength, high fracture toughness composites. The quality and control of manufacture of the multilaminate test specimen blanks was

emphasized. The dimensions, orientation and cure must be meticulous in order to produce the desired mix. J.M.S.

N80-24369*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
THE VISCOELASTIC BEHAVIOR OF A COMPOSITE IN A THERMAL ENVIRONMENT
D. H. Morris, H. F. Brinson, W. I. Griffith, and Y. T. Yeow (Allied Chemical Corp., Morristown, N. J.) Dec. 1979 28 p refs
(Grant NsG-2038)
(NASA-CR-163187; VPI-E-79-40) Avail: NTIS HC A03/MF A01 CSCL 11D

A proposed method for the accelerated predictions of modulus and life times for time dependent polymer matrix composite laminates is presented. The method, based on the time temperature superposition principle and lamination theory, is described in detail. Unidirectional reciprocal of compliance master curves and the shift functions needed are presented and discussed. Master curves for arbitrarily oriented unidirectional laminates are predicted and compared with experimental results obtained from master curves generated from 15 minute tests and with 25 hour tests. Good agreement is shown. Predicted 30 deg and 60 deg unidirectional strength master curves are presented and compared to results of creep rupture tests. Reasonable agreement is demonstrated. In addition, creep rupture results for a (90 deg + or - 60 deg/90 deg) sub 2s laminate are presented. Author

N80-24370*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
THE ACCELERATED CHARACTERIZATION OF VISCOELASTIC COMPOSITE MATERIALS Ph.D. Thesis
W. I. Griffith, D. H. Morris, and H. F. Brinson Apr. 1980 167 p refs
(Grant NsG-2038)
(NASA-CR-163188; VPI-E-80-15) Avail: NTIS HC A08/MF A01 CSCL 11D

Necessary fundamentals relative to composite materials and viscoelasticity are reviewed. The accelerated characterization techniques of time temperature superposition and time temperature stress superposition are described. An experimental procedure for applying the latter to composites is given along with results obtained on a particular T300/934 graphite/epoxy. The accelerated characterization predictions are found in good agreement with actual long term tests. A postcuring phenomenon is discussed that necessitates thermal conditioning of the specimen prior to testing. A closely related phenomenon of physical aging is described as well as the effect of each on the glass transition temperature and strength. Creep rupture results are provided for a variety of geometries and temperatures for T300/934 graphite/epoxy. The results are found to compare reasonably with a modified kinetic rate theory. A.R.H.

N80-24371*# Naval Surface Weapons Center, Dahlgren, Va.
BURN/BLAST TESTS OF MISCELLANEOUS GRAPHITE COMPOSITE PARTS Final Report
T. C. Babinsky and K. A. Musselman Nov. 1979 37 p refs Sponsored by NASA. Langley Research Center
(W0852000)
(NASA-CR-163310; AD-A081712; NSWC/TR-79-390) Avail: NTIS HC A03/MF A01 CSCL 11/4

This report describes the work performed by the Naval Surface Weapons Center on tests conducted for NASA, Langley Research Center for a series of burn/blast tests with various graphite-reinforced composite materials and aircraft components. These tests were a continuation of a series requested by NASA, and, as in previous tests, information concerning the effects of fire and/or explosion upon aircraft structural composite materials and size distribution and dissemination patterns of released fiber materials for risk analyses was obtained. Electrical hazards associated with the released fibers should be the same with these materials as with previously tested materials, but final risk assessment is dependent also on other factors being investigated under the overall NASA program. GRA

N80-24372# Rockwell International Corp., El Segundo, Calif.
THE NUCLEAR THERMAL EFFECTS ON HUMIDITY SATURATED COMPOSITE MATERIALS Final Report, Dec. 1977 - Feb. 1979
Craig Sparling Feb. 1979 83 p
(Contract DNA001-78-C-0062)
(AD-A077195; AD-E300616; DNA-4860F) Avail: NTIS HC A05/MF A01 CSCL 11/4

The primary objective of this program was the development of composite design data in the area of nuclear hardness after humidity saturation. Over 4,000 specimens were fabricated and tested during this program. It was demonstrated that humidity saturation substantially lowers the nuclear thermal flash damage threshold of organic composites. GRA

N80-24373# Texas Univ. at Austin. Dept. of Mechanical Engineering.
INTERFACE CHARACTER OF ALUMINUM/GRAPHITE METAL MATRIX COMPOSITES Technical Progress Report, 1 Dec. 1977 - 30 Nov. 1979
Harris L. Marcus and Daniel Laser Dec. 1979 86 p refs
(Contract N00014-78-C-0094)
(AD-A078828) Avail: NTIS HC A05/MF A01 CSCL 11/4

One of the problems limiting the application of the aluminum/graphite composites to structural applications is the poor transverse properties. This research program has as a primary purpose the understanding of the contributing factors that govern the transverse strength and methods to improve it. In order to develop a better understanding of the character of the aluminum/graphite interface, a series of experimental approaches have been used. The key approaches taken are: (1) Scanning Auger Electron Spectroscopy (SAM) of the fractured surface; (2) Auger Spectrum deconvolution techniques to evaluate bonding state; (3) X-ray Residual Stress Measurements; (4) TEM - Interface Phase Identification; and (5) Electronic characterization of the interface. The combined approaches are being used to separate out the many factors that may influence the interface strength. GRA

N80-24374# Hercules, Inc., Cumberland, Md. Allegany Ballistics Lab.
DESIGN, PROTOTYPE FABRICATION AND MANUFACTURING TECHNIQUES FOR A COMPOSITE BOX BEAM Final Report, Oct. 1977 - Jun. 1979
W. B. Stewart Nov. 1979 128 p refs
(Contract DAAG46-77-C-0069; DA Proj. 1L2-63102-D-071)
(AD-A082231; A0296-610-03-009; AMMRC-TR-79-55) Avail: NTIS HC A07/MF A01 CSCL 11/4

Several composite systems were evaluated and the most appropriate was selected to fabricate two geometric half-scale versions of a full scale traversing launch beam. One beam was subsequently tested in four-point-bending. GRA

N80-24375# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Materials Engineering.
THERMAL-MECHANICAL AND THERMAL BEHAVIOR OF HIGH-TEMPERATURE STRUCTURAL MATERIALS Interim Report, 1 Jan. - 31 Dec. 1979
D. P. H. Hasselman, P. F. Becher, L. D. Bentsen, M. P. Kamat, K. Mazdiyasni, R. J. Palicka, B. R. Powell, J. A. Rubin, K. Satyamurthy, J. P. Singh et al 31 Dec. 1979 215 p refs
(Contract N00014-78-C-0431)
(AD-A081915) Avail: NTIS HC A10/MF A01 CSCL 11/4

Topics covered include (1) effect of heat transfer variables on thermal stress resistance of brittle ceramics measured by quenching experiments; (2) effect of spatially varying thermal conductivity on thermal stress in brittle ceramics subjected to convective heating; (3) effect of data scatter on apparent thermal stress failure mode of brittle ceramics; (4) effect of spatially varying porosity on magnitude of thermal stress during steady state heat flow; (5) The thermal diffusivity of glass Ni composites; (6) the resistance of high E, low E brittle composites to failure by thermal shock; (7) thermal stress analysis of brittle ceramics with density gradients; (8) thermal stress resistance of partially absorbing ceramic plate subjected to asymmetric radiation; (9) micro-cracking in brittle composites; (10) transient thermal stresses in cylinders with square cross section; (11) effect of microcracking on thermal conductivity analysis and experiments, and (12) The Role of Thermal Expansion in the Thermal-Stress Resistance of Semi-absorbing Brittle Materials Subject to Severe Thermal Radiation. GRA

N80-24376# Michigan Univ., Ann Arbor. Dept of Mechanical Engineering.
MOISTURE ABSORPTION OF EPOXY MATRIX COMPOSITES IMMERSED IN LIQUIDS AND IN HUMID AIR Final Report, Mar. - Sep. 1979
George S. Springer and Alfred C. Loos Wright-Patterson AFB, Ohio AFML Oct. 1979 63 p refs
(Contract F33615-75-C-5165)
(AD-A082159; AFML-TR-79-4175) Avail: NTIS HC A04/MF A01 CSCL 11/4

Moisture absorption of graphite-epoxy composites immersed in liquids and in humid air were investigated. The moisture content as a function of time and temperature was measured for three materials: Fiberite T300/1034, Hercules AS/3501-5 and Narmco T300/5208. Tests were performed (1) with the materials immersed in No. 2 diesel fuel, in jet A fuel, in aviation oil, in saturated salt water, and in distilled water (in the range 300 to 322 K) and (2) with the materials exposed to humid air (in the range 322 to 366 K). The results obtained were compared to available composite and neat resin data. Moisture absorption of a boron-epoxy, graphite-epoxy hybrid composite immersed in humid air and in saturated steam was also measured. GRA

N80-24377# Lockheed-California Co., Burbank.
THE EFFECT OF COMPRESSIVE LOADING ON THE FATIGUE LIFETIME OF GRAPHITE/EPOXY LAMINATES Final Technical Report, 31 May 1977 - 2 Aug. 1979
J. T. Ryder and E. K. Walker Wright-Patterson AFB, Ohio AFML Jan. 1979 378 p refs
(Contract F33615-77-C-5045; AF Proj. 2419)
(AD-A082150; LR-29168; AFML-TR-79-4128) Avail: NTIS HC A17/MF A01 CSCL 11/4

The main objective of this research investigation was the effect of compressive loading on the fatigue response of graphite epoxy laminates as influenced by a circular hole and an aggressive environment. The investigation was undertaken in order to further characterize the behavior of graphite/epoxy laminates under fatigue loading. The primary emphasis of the program was on the accumulation of a statistically significant data base. Unnotched coupon properties of a quasi-isotropic and a 67% 0 degrees fiber laminate were investigated in a 82.2 degrees C (180 degrees F), 90% R.H. environment after prior conditioning in that environment. The interactional effects of absorbed moisture and fatigue loading on the fatigue lifetime of coupons containing a circular hole was investigated at room temperature and at 82.2 degrees C (180 degrees F), 90% R.H. using the quasi-isotropic laminate. The test program consisted of static tension and compression tests; tension-tension and tension-compression fatigue tests; and static tension and compression residual strength tests of coupons prior tested either under tension-tension or tension-compression fatigue loading. GRA

N80-24378# General Dynamics Corp. Fort Worth, Tex.
IN-SERVICE INSPECTION OF ADVANCED COMPOSITE AIRCRAFT STRUCTURE Final Report, 1 Mar. - 31 Dec. 1978
Francis H. Chang, Jerry R. Bell, Alvis H. Gardner, Gerald P. Handley, and C. Patrick Fischer Wright-Patterson AFB, Ohio AFML Feb. 1979 118 p refs
(Contract F33615-77-C-5206; AF Proj. 2418)
(AD-A082331; FZM-6816; AFML-TR-79-4087) Avail: NTIS HC A06/MF A01 CSCL 11/4

This report describes the work accomplished under a 12 month program conducted for the purpose of developing a reliable and practical inspection and data recording capability for service induced, or propagated flaws in composite aircraft structure. The basis of the developmental work was a portable C-scan recording system developed by General Dynamics to be used in hand-scan ultrasonic inspection on F-16 production line. In that system, a unique sonic microphone digitizing system was used to receive low-frequency ultrasound generated by a cursor attached to the ultrasonic transducer for position indication. In this program, a laboratory mock-up system was assembled to detect and record implanted flaws and impact damages in fabricated specimens, using modified and improved ultrasonic techniques. Preliminary design of a prototype system incorporating improvements from the laboratory mock-up system was completed. A cost analysis was conducted to allow an evaluation of the performance of the prototype system in the preliminary design against its cost. GRA

N80-24379# Boeing Aerospace Co., Seattle, Wash.
ADVANCED THERMOPLASTIC COMPOSITE DEVELOPMENT Final Report, 4 Nov. 1977 - 4 Feb. 1979
S. G. Hill, E. E. House, and J. T. Hoggatt May 1979 68 p refs
(Contract N00019-71-C-0561)
(AD-A081978; D180-25734-1) Avail: NTIS HC A04/MF A01 CSCL 11/4

The objective of this program was to evaluate recently developed thermoplastic resins as matrix materials for graphite reinforced composites. Thermoplastic polymers (PKXA Polysulfone, Radel 5010 polyphenylsulfone, P-300, and KM-1 polyethersulfones, and CM-1 fluorocarbon based resin) having high temperature capability (-350 F) were evaluated as matrix materials for graphite reinforced composites. Resin characterization studies were performed. Prepreg processing and laminate molding parameters were optimized. Mechanical properties evaluations conducted consisted of flexure, tension, compression, shear, bearing, and impact strength. A study was conducted to determine resistance of the graphite fabric/thermoplastic composites to fluids likely to be encountered in aircraft flight and maintenance operations. Thin (0.01 in.) titanium sheet was bonded to the laminate faces and these 'clad' specimens immersed in fluids to determine if the clad specimens were more fluid resistant than unclad specimens. Postforming and thermal cycling studies were performed on the clad specimens. The feasibility of using two joining methods, spot fusion and use of a glue gun, for attaching graphite reinforced composite repairs patches to graphite reinforced composite structure was demonstrated. GRA

N80-24380# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Nonmetallic Materials Div.
PROCEEDINGS OF THE FIFTH ANNUAL MECHANICS OF COMPOSITES REVIEW
Karyn T. Knoll, ed. Jan. 1980 237 p refs Review held 30 Oct. - 1 Nov. 1979; sponsored by AFML
(AF Proj. 2419)
(AD-A082846; AFWAL-TR-80-4020) Avail: NTIS HC A11/MF A01 CSCL 11/4

Unedited papers presented by representatives of NASA and of various DOD agencies discuss the mechanical properties, fracture mechanics, fatigue life, weathering, and interferometric testing of fiber composites, metal matrix composites, epoxy matrix composites, and composite structures. An interactive program for the optimum design of stiffened cylindrical panels, and methods for modeling critical flaws in graphite fiber reinforced resin matrix composites are described and the effects of engine environment on composite are also considered. A listing of both the inhouse and contractual activities of each participating organization is included. A.R.H.

N80-24381# Illinois Univ. at Urbana-Champaign. Dept. of Ceramic Engineering.
DENSIFICATION OF ZIRCONIA WITH BORATES Interim Research Report, 1 Mar. 1979 - 28 Feb. 1980
A. Sircar and R. C. Buchanan 24 Jan. 1980 49 p refs
(Contract N00014-78-C-0279)
(AD-A082760; TR-3) Avail: NTIS HC A03/MF A01 CSCL 07/2

Sintering studies carried out on submicron CaO (6.5 percent by weight) stabilized ZrO powders, showed borate additions (1-10 percent by weight) to be effective densification aids. Densities greater than 99% estimated theoretical were obtained at 1200 degrees C/4 hours, with 2 percent by weight B2O3 or 5 percent by weight CaO borate (CaO.2B2O3; (CaO.B2O3)) additions to these powders. GRA

N80-24382# Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev. Energy Measurements Group.
CORNER BURN TEST OF COMPOSITE MATERIALS
A. D. Adamitis and F. M. Bowman Nov. 1979 72 p
(Contract EY-76-C-08-1183)
(EGG-1183-1717-Rev-1) Avail: NTIS HC A04/MF A01

The data obtained from igniting and burning a specimen structure representing an instrumentation trailer are discussed.

The test shows that the combination of the fire retardant materials did withstand the type of fire anticipated in a typical trailer, minimizing damage and losses to the facility. The possibility of a total loss due to fire in a structure built of these materials would be reduced significantly if fuel loading does not exceed 14 pounds. Also, the combination of fire retardant materials did not create dangerous outgassing or the possibility of explosion due to vapor mixture. Additionally, the test establishes a base of information that can be used for comparison, if other labeled materials were chosen for construction. DOE

N80-24383# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Werkstoff-Forschung.

THE INFLUENCE OF PROCESSING CONDITIONS ON THE MICROSTRUCTURE AND THE MECHANICAL PROPERTIES OF REACTION SINTERED SILICON NITRIDE Ph.D. Thesis - Technische Univ., Berlin

Juergen Heinrich Sep. 1979 103 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-650)

(DFVLR-FB-79-32) Avail: NTIS HC A06/MF A01; DFVLR, Cologne DM 19,40

The microstructure of reaction sintered silicon nitride was changed by varying green density, grain size of the silicon powder, nitriding conditions, and by introducing artificial pores. The influence of single microstructural parameters on mechanical properties such as room temperature strength, creep behavior, and resistance to thermal shock was investigated. Author (ESA)

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

N80-24384 Georgia Univ., Athens.

FUNDAMENTAL STUDIES IN HIGH TEMPERATURE AND REVERSED PHASE LIQUID CHROMATOGRAPHY Ph.D. Thesis

Jeffrey Alan Graham 1979 138 p

Avail: Univ. Microfilms Order No. 8010588

Pressure programmed supercritical fluid chromatography was investigated. Under optimized conditions, particle diameters in the range of 122 micrometers to 205 micrometers were found to yield maximum resolution of ohgomers of 800 molecular weight polystyrene when 5% isopropanol in pentane was employed as a mobile phase at 240 C. The ability of a given column to achieve maximum resolution was found to be dependent on the ratio of the pressure programming rate to the average mobile phase flow rate. The effects of addition of surfactants to aqueous mobile phases of a reversed phase liquid chromatographic system on the capacity factors of six nonionic solutes were also investigated. Capacity factors were generally observed to decrease upon addition 5.0 x 10 to the minus 5 power M and 5.0 x 10 to the minus 3 power M sodium dodecylsulfate. The magnitude of the observed reduction was found to be a function of the mobile phase composition, the concentration of the surfactant in the mobile phase the hydrophobicity of the surfactant and the hydrophobicity of the solute. Dissert. Abstr.

N80-24385 Kent State Univ., Ohio.

CHEMICAL ANALYSIS BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY WITH ELECTROCHEMICAL DETECTION Ph.D. Thesis

William John Mayer 1979 131 p

Avail: Univ. Microfilms Order No. 8011563

The electrochemical detector takes advantage of the difference in the voltammetric characteristics between the sample and the background solvents/electrolyte used as the mobile phase. If the electrochemical detector is set at a potential characteristic peak of the oxidation or reduction potential of the sample, it is possible to observe a normal Gaussian chromatographic peak as the sample is oxidized or reduced as it is eluted from the HPLC column. Interferences can be eliminated by either choosing the cell potential low enough so that the interferences will not be observed, or choosing an electrochemical mode of operation that will selectively identify the desired sample. The separation and quantification of theophylline from related molecules of theobromine and caffeine in blood serum are described as well as the determination of oxalic acid concentration in urine and the separation of carbamate pesticides. Dissert. Abstr.

N80-24386*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN INTERACTIVE MODULAR DESIGN FOR COMPUTERIZED PHOTOMETRY IN SPECTROCHEMICAL ANALYSIS

Virginia L. Bair 1980 17 p Presented at the Pittsburgh Conf. on Anal. Chem. and Appl. Spectry., Atlantic City, 10-14 Mar. 1980; cosponsored by the Soc. for Anal. Chemists of Pittsburgh and the Spectry. Soc. of Pittsburgh

(NASA-TM-81521; E-465) Avail: NTIS HC A02/MF A01 CSCL 07D

A general functional description of totally automatic photometry of emission spectra is not available for an operating environment in which the sample compositions and analysis procedures are low-volume and non-routine. The advantages of using an interactive approach to computer control in such an operating environment are demonstrated. This approach includes modular subroutines selected at multiple-option, menu-style decision points. This style of programming is used to trace elemental determinations, including the automated reading of spectrographic plates produced by a 3.4 m Ebert mount spectrograph using a dc-arc in an argon atmosphere. The simplified control logic and modular subroutine approach facilitates innovative research and program development, yet is easily adapted to routine tasks. Operator confidence and control are increased by the built-in options including degree of automation, amount of intermediate data printed out, amount of user prompting, and multidirectional decision points. A.R.H.

N80-24387*# Purdue Univ., Lafayette, Ind. Dept. of Physics.

ATOMIC EMISSION SPECTROSCOPY Final Technical Report, 1 Feb. 1969 - 31 Jan. 1975

Kenneth H. Andrew 31 Jan. 1975 10 p refs

(Grant NGL-15-005-003)

(NASA-CR-163184) Avail: NTIS HC A02/MF A01 CSCL 07D

The relationship between the Slater-Condon theory and the conditions within the atom as revealed by experimental data was investigated. The first spectrum of Si, Rb, Cl, Br, I, Ne, Ar, and Xe-136 and the second spectrum of As, Cu, and P were determined. Methods for assessing the phase stability of fringe counting interferometers and the design of an autoranging scanning system for digitizing the output of an infrared spectrometer and recording it on magnetic tape are described. A.R.H.

N80-24388# Rome Air Development Center, Griffiss AFB, N.Y.

SWEEPING AND Q MEASUREMENTS AT ELEVATED TEMPERATURES IN QUARTZ

R. N. Brown, J. J. OConnor, and A. F. Armington May 1979 33 p refs

(AF Proj. 2306)

(AD-A081463; RADC-TR-79-175) Avail: NTIS HC A03/MF A01 CSCL 07/4

Results of sweeping experiments on synthetic quartz are presented. Sweeping was performed with an inert gas atmosphere below the transition temperature. An electric field of 1000 V/cm was employed. Alkali ions were observed to deposit on both electrodes. Doping was performed by sweeping alkali ions into the quartz. A Q-measuring technique was developed to evaluate the effects of sweeping and doping. GRA

N80-24389# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.

THEORY AND EXPERIMENTS ON CHEMICAL DYNAMICS AND INSTABILITIES Final Scientific Report, 1 Dec. 1976 - 30 Nov. 1979

John Ross Jan. 1980 16 p refs

(Grant AF-AFOSR-0169-80; AF Proj. 2303)
(AD-A082147; AFOSR-80-0169TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

We have used the Franck Condon theory to calculate planar and three dimensional angular distributions for the reaction products of atom-diatom chemical reactions. After applying the Franck Condon approximation we consider the limits of weak and strong potential coupling in the limits of weak and strong kinematic coupling. For H + H2 we find our results in the strong potential limit to be in qualitative agreement with exact quantum mechanical calculations. We have used some results from the theory of propagation of discontinuities in systems with chemical instabilities for the purpose of an analysis of the motion of domain walls in ferrodistortive materials. When a fluid, gas or liquid, is subjected to a temperature gradient in the gravitational field, then convective instabilities, called Rayleigh-Bernard instabilities, may occur. We have re-investigated this much studied problem since previous work did not consider the inclusion of cross transport coefficients such as thermal diffusion (Soret effect) and the reciprocal phenomena known as the Dufour effect. We used the hydrodynamic equations in the Boussineoq approximation and studied their stability to the onset of both stationary and oscillatory convection. We find a variation principle for the critical Rayleigh number at the onset of stationary convection which depends on a single dimensionless parameter, a function of the thermo-dynamic coefficients. GRA

N80-24390# New York Univ., N. Y. Dept. of Chemistry.
VACUUM ULTRAVIOLET PHOTOELECTRON EMISSION SPECTROSCOPY OF WATER AND AQUEOUS SOLUTIONS
Iwao Watanabe, James B. Flanagan, and Paul Delahay Feb. 1980 34 p refs
(Contract N00014-75-C-0397)
(AD-A081980; TR-11) Avail: NTIS HC A03/MF A01 CSCL 07/4

Experimental methods are developed for the photoelectron emission spectroscopy of water and aqueous solutions (halides, hydroxyl ion, phosphoric acid and phosphates) up to 10.5 eV. The yield for emission of photoelectrons by the liquid into water vapor is measured as a function of photon energy. Threshold energies are determined by extrapolation from emission spectra. Photoelectron emission by liquid water obeys Urbach's rule and has a threshold energy of 9.3 + or - 0.3 eV. This threshold is compared with the literature value of 8.7 + or - 0.1 eV for the threshold energy for amorphous ice. Threshold energies for halide and hydroxyl ions are obtained by application of the Brodsky-Tsarevsky theory of photoelectron emission by solutions: 8.7, 7.9, 7.2, 8.4 eV, respectively, for Cl-, Br-, I-, OH- ions. The emission spectrum for Br is deconvoluted for spin-orbit coupling. The threshold energies of these ions are higher by 1.6 to 1.8 eV than the energies at the maxima of the corresponding charge-transfer-to-solvent absorption spectra. The difference of 1.6 to 1.8 eV agrees with a theoretical prediction. Preliminary results are reported on the effect of ionic charge on the emission of phosphoric acid and phosphate ions. GRA

N80-24391# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A METHOD FOR COMPUTING THE FLAME SPEED OF A LAMINAR, PREMIXED, ONE DIMENSIONAL FLAME
T. P. Coffee and J. M. Heimerl Jan. 1980 151 p refs
(DA Proj. 1L1-61102-AH-43)
(AD-A082803; AD-B430386; ARBRL-TR-02212) Avail: NTIS HC A08/MF A01 CSCL 21/2

A method of numerically solving the equations for a one dimensional, premixed, laminar, steady state flame that propagates into an unbounded medium is described. Particular attention is given to the description of an adaptive grid, which concentrates gridpoints within the flame front. GRA

N80-24392# California Univ., Livermore. Lawrence Livermore Lab.
MEASUREMENT OF SULFUR CONTENT OF FLUIDS BY X-RAY FLUORESCENCE
R. W. Ryon Dec. 1979 7 p
(Contract W-7405-eng-48)
(UCID-18508) Avail: NTIS HC A02/MF A01

A nondestructive method is described for the quantitative measurement of sulfur in oils and water. The method is rapid, sensitive, and accurate. A wavelength dispersive x-ray spectrometer is used. Excitation is produced by a rhodium target, grounded cathode, 0.005 inch Be end window x-ray tube. When a 35 mm diam. specimen cell is used, 1% sulfur in oil yields 19,000 c/s. The detection limit for sulfur is estimated to be less than 5 ppM. DOE

N80-24393# Electrochemical Technology Corp., Seattle, Wash.
SURVEY OF ORGANIC ELECTROLYTIC PROCESSES Final Report
T. R. Beck, R. T. Ruggeri, R. C. Alkirk (Illinois Univ., Urbana), M. A. Stadherr (Illinois Univ., Urbana), and N. L. Weinberg Nov. 1979 272 p refs
(Contract W-31-109-eng-38)
(ANL/OEPM-79-5) Avail: NTIS HC A12/MF A01

The commercial status of electroorganic processes and whether there would be significant possible energy savings by introduction of electroorganic processes to replace conventional chemical processes for production of certain large-tonnage organic chemicals were determined. A list was compiled of the 220 organic chemicals that were produced at greater than 10,000 tons per year in 1975 in the United States. Search of the Swann and of the Fichter Bibliographies of electroorganic literature yielded references on 95 of these compounds. By application of selection rules to obtain promising candidates, nine chemicals with diverse electrochemical processes were chosen for detailed process energy calculations. Parallel calculations were made for presently-used commercial chemical routes to these products. Two of the nine electrochemical processes, adiponitrile and methyl ethyl ketone, had energy savings in comparison to the corresponding chemical processes. DOE

N80-24394# Argonne National Lab., Ill. Chemical Engineering Div.
WETTING BEHAVIOR OF MOLTEN-CHLORIDE ELECTROLYTES: CAPILLARITY EFFECTS IN LITHIUM-ALUMINUM/METAL SULFIDE BATTERIES
J. G. Eberhart (Aurora Coll., Ill.) Aug. 1979 41 p refs
(Contract W-31-109-eng-38)
(ANL-79-34) Avail: NTIS HC A03/MF A01

A lithium-aluminum/iron sulfide battery which uses a molten LiCl-KCl electrolyte is described. The performance and lifetime of this electrochemical system depend, in part, on the ability of the electrolyte to wet the materials used as electrodes, separators, and particle retainers. For this reason contact-angle measurements were made on smooth, 100%-dense surfaces of the cell materials. In addition, electrolyte penetrability determinations were made on the porous materials actually used as cell separators and particle retainers. The results of these measurements led to techniques for completely filling porous cell components with electrolyte, suggestions for dealing with the problem of electrolyte creeping, estimates of the likelihood of electrolyte transfer from one porous component to another, and estimation of the maximum allowable vertical cell dimensions. DOE

N80-24395# Oak Ridge Y-12 Plant, Tenn. Plant Lab. Dept.
DETERMINATION OF HYDROGEN IN URANIUM-NIOBIUM-ZIRCONIUM ALLOY BY INERT-GAS FUSION
W. F. Carden Dec. 1979 18 p ref
(Contract W-7405-eng-26)
(Y-2194) Avail: NTIS HC A02/MF A01

A method using inert-gas fusion for determining the hydrogen content in uranium-niobium-zirconium (U-7.5Nb-2.5Zr) alloy is described. The method is applicable to concentrations of hydrogen ranging from 1 to 250 micrograms per gram and may be adjusted for analysis of greater hydrogen concentrations. Hydrogen is determined using a hydrogen determinator. The limit of error for a single determination at a 95 percent-confidence level (at the 3.7 microgram/gram hydrogen level) is + or - 1.4 micrograms per gram hydrogen. DOE

N80-24396# Oak Ridge Y-12 Plant, Tenn. Plant Lab. Dept.
DETERMINATION OF NITROGEN AND OXYGEN IN URANIUM METAL BY INERT-GAS FUSION
W. F. Carden 31 Dec. 1979 19 p
(Contract W-7405-eng-26)
(Y-2193) Avail: NTIS HC A02/MF A01

An analytical method using inert-gas fusion for determining the nitrogen and the oxygen contents of uranium metal is described. The analytical method is applicable to concentrations of nitrogen and oxygen ranging from 1 microgram per gram to 1000 micrograms per gram for each gas. In uranium metal, the limit of error for a single determinaiton at the 95%-confidence level, at the 12 micrograms per-gram-nitrogen level, is +-3 micrograms per gram nitrogen and, at the 20 micrograms-per-gram-oxygen level, is +-3 micrograms per gram oxygen. Nitrogen and oxygen concentrations are determined by using a nitrogen-oxygen determinator. DOE

N80-24397 Sandia Labs., Livermore, Calif.
LASER ABSORPTION MEASUREMENTS OF OH IN A METHANE-AIR FLAT FLAME
Robert J. Cattolica Dec. 1979 79 p refs Presented at the 1979 Fall Combustion Meeting, Berkeley, Calif., 15-16 Oct. 1979
(Contracts EY-76-C-04-0789; DE-AC04-76DP-00789)
(SAND-79-8717; CONF-791048-5) Avail: NTIS HC A04/MF A01

The OH radical concentration and rotational temperature were measured in atmospheric pressure methane-air flat flames using absorption spectra obtained with a tunable dye laser. The OH radical nonequilibrium and the associated recombination in the post flame gases were observed for fuel-air equivalence ratios of .8, .9, 1.0, 1.1, 1.2. The predicted peak OH concentrations from one dimensional laminar flame models were found to be in good agreement with the measured values. The OH decay profiles were consistent with a second-order dependence of the decay on the OH concentration. Although this dependence is associated with the recombination chemistry for the fuel rich flames, it appears that for the lean flames diffusional transport is responsible. The OH decay rate constant was nearly the same for the stoichiometric and lean conditions, but was found to increase substantially for the fuel-rich conditions. DOE

N80-24398# Bendix Field Engineering Corp., Grand Junction, Colo.
HIGH RESOLUTION GAMMA-RAY SPECTROSCOPY APPLIED TO BULK SAMPLE ANALYSIS
K. L. Kosanke, Chuck D. Koch, and Robert D. Wilson Jan. 1980 62 p refs
(Contract EY-76-C-13-1664)
(GJBX-4(80)) Avail: NTIS HC A04/MF A01

A high resolution Ge(Li) gamma-ray spectrometer was installed and made operational for use in routine bulk sample analysis. The Ge(Li) spectrometer provides bulk sample analyses for potassium, uranium, and thorium that are superior to those obtained by the sodium iodide spectrometer. The near term analysis scheme permits a direct assay for uranium that corrects for bulk sample self-absorption effects and is independent of the uranium/radium disequilibrium condition of the sample. A more complete analysis scheme was developed that fully utilizes the gamma-ray data provided by the Ge(Li) spectrometer and that more properly accounts for the sample self-absorption effect. This new analysis scheme should be implemented on the Ge(Li) spectrometer at the earliest date. DOE

N80-24399# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
LIQUID SCINTILLATION ALPHA PARTICLE SPECTROMETRY Progress Report
L. L. Bell, S. A. Hakooz, L. O. Johnson, E. B. Nieschmidt, and D. H. Meikrantz (Exxon Nuclear Idaho Corp.) Dec. 1979 72 p refs
(Contract EY-76-C-07-1570)
(EGG-phys-5058) Avail: NTIS HC A04/MF A01

A technique is developed whereby plutonium may be put into solution, extracted by solvent, extracted into a suitable extractive scintillant, and subsequently counted. Separation of beta and alpha activities through pulse shape discrimination is attempted. A qualitative discussion is given which yields alpha particle peak widths, resolution, and response. The detection efficiency for alpha particles in a liquid scintillant is 100%. The detectability of a particular alpha emitting species is strongly dependent upon the population of other species. The ability to discriminate depends upon the system resolution. DOE

N80-24400# Department of Energy, Washington, D. C.
COMPUTERS IN ACTIVATION ANALYSIS AND GAMMA RAY SPECTROSCOPY. PROCEEDINGS OF THE AMERICAN NUCLEAR SOCIETY TOPICAL CONFERENCE
R. S. Carpenter, ed. (NBS, Washington, D.C.), Michael D. DAgostino, ed. (Grumman Aerospace Corp., Bethpage, N.Y.), and Herbert P. Yule, ed. (Nuclear Utility Services Inc., Washington, D.C.) 1979 905 p refs Conf. held at Mayaguez, Puerto Rico, 30 Apr. - 4 May 1978; sponsored by Am. Nucl. Soc., Am. Chem. Soc., NBS, Puerto Rico Univ., Center for Energy and Environ. Res., and DOE
(CONF-780421) Avail: NTIS HC A99/MF A01

Seventy-three papers are included under the following session headings: analytical and mathematical methods for data analysis; software systems for gamma ray and X-ray spectrometry; gamma-ray spectra treatment, peak evaluation; least squares; IAEA intercomparison of method for processing spectra; computer and calculator utilization in spectrometer systems; and applications in safeguards, fuel scanning, and environmental monitoring. Separate abstracts were prepared for 72 of those papers. DOE

N80-24401# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
STUDIES IN CHEMICAL REACTIVITY Progress Report, 1 Jan. - 31 Dec. 1979
R. W. Carr, Jr. Dec. 1979 15 p refs
(Contract EY-76-S-02-2026)
(COO-2026-39) Avail: NTIS HC A02/MF A01

Data on the collisional deactivation of chemically activated polyatomic molecules show a trend of decreasing Delta E, the average energy removal per gas kinetic collision, with increasing size of activated molecule when polyatomic collider species of similar molecular structure and nearly constant number of atoms are used. Calculations of Delta E by a quasistatistical transition modes model give quantitative agreement with the experimental data. Measurements of photoionization cross sections and yields of some organic molecules were made in a double ionization chamber. Work is proceeding on an experiment to detect chemically activated molecules by photoionization. Observation were made of the production of CF2 in the flash photolysis of 1, 3 dichlorotetrafluoroacetone, and the rate of removal of CF2 by reaction. Observation have also been made on the production and removal of C10 when O2 is present in the reaction. Analysis of reaction products from steady illumination photolysis of 1, 3 dichlorotetrafluoroacetone and oxygen mixtures at 313 nm were done by gas chromatography, infrared spectrometry and mass spectrometry. Continued efforts to observe CH2(B1) yields CH2(A1) luminescence from photolysis of ketene, diazomethane and diazirine were unsuccessful. DOE

N80-24402# Argonne National Lab., Ill.
PULSED NEURON ACTIVATION CALIBRATION TECHNIQUE
Paul Kehler 1979 13 p refs Presented at the 7th Water Reactor Safety Res. Inform. Meeting, Gaithersburg, Md., 5-9 Nov. 1979
(Contract W-31-109-eng-38)
(CONF-791118-7) Avail: NTIS HC A02/MF A01

A pulsed neutron activation for measurement of two-phase flow is described. Flow was measured downstream by an NaI detector. Measured counts were sorted by a multiscaler into different time channels. A counts vs. time distribution typical for two phase flow with slip between the two phases was obtained. Proper evaluation for the counts/time distribution lead to flow regime independent equations for the average of the inverse transit time and the average density. After calculation of the average mass flow velocity, the true mass flow was derived. DOE

N80-24403# Los Alamos Scientific Lab., N. Mex.
FLOWING AFTERGLOW SPECTROSCOPY: AN ULTRASENSITIVE PROBE INTO SOLID-PHASE DECOMPOSITION KINETICS
George W. Taylor and George H. Andrews, Jr. 1979 30 p refs Presented at the 7th Ann. DOE Compatibility Conf., Aiken, S.C., 16 Oct. 1979
(Contract W-7405-eng-36)
(LA-UR-80-56; CONF-791079-3) Avail: NTIS

HC A03/MF A01

The thermal decomposition kinetics of high explosives are discussed with respect to the processing and storage of these dangerous materials. Two broad temperature regions are of particular importance, i.e., the high (greater than or equal to 200 C) temperature region associated with fire hazard and the low (approximately 20 to 200 C) region associated with storage and processing environments. The technique is described in detail and efforts to elucidate the low temperature kinetics of trinitrotriaminobenzene and nitroguanidine are summarized. DOE

N80-24404# California Univ., Berkeley. Lawrence Berkeley Lab. Nuclear Science Div.

NEW DEVELOPMENTS IN GAMMA-RAY CONTINUUM SPECTROSCOPY

R. M. Diamond Dec. 1979 16 p refs Presented at the Intern. Symp. on Continuum Spectra, San Antonio, Tex., 3 Dec. 1979

(Contract W-7405-eng-48)

(LBL-10137; CONF-791219-3) Avail: NTIS HC A02/MF A01

The development of gamma ray spectroscopy for the investigation of high spin states is discussed. In such studies, selection of particular (high) spin regions are made through use of multiplicity filters and total-energy spectrometers. The nuclei investigated so far, whether initially near-spherical or deformed, all appear to become deformed rotors at high spin, and effective moments of inertia can be obtained. A new technique of determining energy correlations among coincident transitions in the cascade offers great promise for the future. DOE

N80-24405# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Information Processing Computer Science.

KINRATE AND KINBOX: TWO PROGRAM PACKAGES FOR INTERACTIVE SIMULATION OF CHEMICAL SYSTEMS

Mathias Uhlen 1979 69 p refs

(TRITA-NA-7912) Avail: NTIS HC A04/MF A01

Two interactive program packages for simulation of chemical reaction systems, KINRATE a program package for simulations of homogenous reaction systems and KINBOX a program package for heterogenous systems, are described. These programs are a further development of a program package, KEMPEX, used in numerical analysis. Each program package contains four different programs. In the first, the chemical system is defined by the user and the kinetics are automatically translated into ordinary differential equations. In the second program, chemical and physical parameters are given, while in the third, the simulation takes place. The fourth program is used to interpret the result, using graphical units. The chemical, physical, and mathematical background which is needed for the computational simulations is also discussed. Two test runs are included, one illustrating an oscillating chemical system (Belousto-Zhabotinsky), and the other illustrating kinetics and diffusion of some components of the atmosphere. Author (ESA)

N80-24406# European Space Agency, Paris (France).

COHERENT ANTI-STOKES RAMAN SCATTERING AT ELECTRONIC RESONANCE: APPLICATION TO IODINE

Brigitte Attal Apr. 1980 143 p refs Transl. into ENGLISH of "Diffusion Raman Anti-Stokes Coherente a la Resonance electronique: Application a l'Iode", Rept. ONERA-1979-4 ONERA, Paris, 1979 Original report in FRENCH previously announced as N80-23404

(ESA-TT-608; ONERA-NT-1979-4) Avail: NTIS HC A07/MF A01

The main properties and application of Coherent Anti-Stokes Raman Scattering (CARS) are recalled and the advantages of resonant excitation pointed out. In particular the intensities of the Raman lines must be enhanced by several orders of magnitude. Specificity is thus improved and detection of traces of polluants in mixtures becomes possible. Results of experiments with NO2 and I2 are presented, and a study of iodine (partial pressure of 1 mb) in air in normal conditions is made. Two spectra were plotted for two distinct values of the laser frequency omega L in the proximity of the b - x transition absorption lines. Enhancement of the intensities of the CARS lines by one-photon resonance is experimentally confirmed in iodine.

Author (ESA)

N80-24407# National Bureau of Standards, Washington, D.C.

JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, VOLUME 84, NUMBER 6 Bimonthly Report, Nov. - Dec. 1979

1979 89 p refs

(PB80-131768) Avail: NTIS HC A05/MF A01 CSCL 07D

Research papers of the NBS are reported. The topics include: molecular dynamics of liquid rubidium; room temperature poly (vanylidene fluoride) with deposited metal electordes; generator for discrete polynomial Li; and coloring algorithm for large scheduling problems. Citations of all recent publication of the National Bureau of Standards are presented. F.O.S.

N80-24408# Ohio State Univ., Columbus. Water Resources Center.

ADSORPTION OF FREE AND COMPLEXED METALS FROM SOLUTION BY ACTIVATED CARBON

Alan J. Rubin and Danny L. Mercer Aug. 1979 76 p refs Sponsored by Dept. of Interior

(PB80-127244; W80-02406; OWRT-A-044-OHIO(1)) Avail: NTIS HC A05/MF A01 CSCL 07D

The effect of two complexing agents of different solubilities on the adsorption of cadmium(II), zinc(II) and lead(II) by activated carbon was investigated. Studies were run to compare carbons of different isoelectric points, particle size, and dosage. The Freundlich and Langmuir isotherms were compared as were curve fitting techniques for evaluating the adsorption parameters. Results indicate that at very low surface coverage, as with an excess of adsorbent, EDTA appears to enhance the sorption of cadmium. Under more realistic conditions, that is, at high surface coverages, the effect of this soluble chelating agent is to suppress adsorption of metal ion. Results also indicate that the use of EDTA is detrimental to metals removal. GRA

N80-24409# Midwest Research Inst., Kansas City, Mo.

SAMPLING AND ANALYSIS OF SELECTED TOXIC SUBSTANCES. TASK 1: ACRYLAMIDE Final Report, Sep. 1978 - Sep. 1979

John E. Going and Ken Thomas Dec. 1979 39 p refs

(Contract EPA-68-01-5017)

(PB80-128150; EPA-560/13-79-013) Avail: NTIS HC A03/MF A01 CSCL 07D

A sampling and analysis program was conducted to determine the level of residual acrylamide monomer in selected polymers and to determine if the use of those polymers in water treatment leads to measurable levels of acrylamide in the water. Methods for the determination of acrylamide in water and in polyacrylamide were validated. Water samples were reduced in volume by evaporation and analyzed by GC using a nitrogen selective thermionic detector. The detection limit was determined to be about 1 microgram/liter. Polyacrylamide samples were extracted with 80 percent methanol/20 percent pH 3.75 water for 3 hr. The extracts were analyzed by HPLC with a UV detector set at 200 nm. The monomer limit of detection was about 0.5 microgram/g. One potable water treatment plant was sampled at pre- and post-flocculation points. MRI tap water was analyzed for comparison. No acrylamide above the detection limit was found in any of the samples. Thirty-two polymers were analyzed for residual acrylamide. When not obscured by interferences, the observed acrylamide ranged from 0.5 to 600 microgram/g. GRA

N80-24410# FilmTec Corp., Minnetonka, Minn.

ADVANCED POLY(PIPERAZINEAMIDE) REVERSE OSMOSIS MEMBRANES Final Report, 27 Sep. 1978 - 26 Sep. 1979

John E. Cadotte, Rita S. King, and Nancy A. Newkumet 1979 54 p refs

(Contract DI-14-34-0001-8512)

(PB80-127574; W80-02401; OWRT-C-80011-S(8512)(1)) Avail: NTIS HC A04/MF A01 CSCL 07C

Poly(piperazineamide) thin-film composite reverse osmosis membranes were prepared by interfacially reacting piperazine compounds with a mixture of isophthaloyl and trimesoyl acid chlorides. Reaction of piperazine itself with these acylhalides gave membranes with high flux and excellent salt rejections towards salts with divalent anions, but relatively poor salt rejections toward salts with monovalent anions. About 95%

seawater rejections were possible. A variety of water-soluble, amine-terminated piperazine oligomers were prepared by reaction of an excess of piperazine with poly-functional acyl halides. These were then used in the above interfacial reaction step. Cyanuric chloride-piperazine adducts showed performance advantages over other in preparation of reverse osmosis membranes interfacially. In seawater tests at 1000 psi and 25C, fluxes of 15 to 20 gfd at 97 percent salt rejection were attainable for poly (piperazineamides) containing cyanuric amide segments. These latter membranes were not chlorine-resistant. GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N80-24411# Aeronautical Research Labs., Melbourne (Australia).
FATIGUE-CRACK GROWTH IN D6AC STEEL HEAT-TREATED TO DIFFERENT VALUES OF FRACTURE TOUGHNESS
N. E. Ryan Apr. 1979 15 p refs
(ARL/MAT-REPT-110; AR-001-734) Avail: NTIS
HC A02/MF A01

Measurements of fatigue-crack growth in D6AC steel, heat-treated to various fracture-toughness levels, show that, under conditions where the growth mechanism produces striation markings and the crack extension per cycle is a linear function of a power of the stress intensity range, the rate of fatigue-crack growth is independent of fracture-toughness. At peak stress intensity values greater than 0.7 K sub 1c, the rate of growth accelerates as the critical stress intensity is approached and tensile modes of crack extension occur. At peak stress intensity values less than 18 MPa m to the 1/2 power, fractographic examination indicates a change in mechanism as the crack extension per cycle decreases more rapidly with decreasing peak stress intensity, approaching a threshold value of stress intensity dependent upon heat-treatment. The implications of these results for the choice of materials for service applications are discussed. Author

N80-24412# Washington State Univ., Pullman. Dept. of Physics.
TRIBOSTIMULATED EXOEMISSION FROM OXIDE COVERED METALS Final Report, 1 Jun. 1978 - 31 Oct. 1979
J. T. Dickinson and P. F. Braeunlich Jan. 1980 56 p refs
(Grant AF-AFOSR-3650-78; AF Proj. 2306)
(AD-A081477; AFOSR-80-0137TR) Avail: NTIS
HC A04/MF A01 CSCL 07/4

This report presents a summary of the work performed by Washington State University under Grant No. 78-3650 during June 1978 to October 1979. This report covers a number of experiments concerning emission phenomena accompanying plastic deformation of anodized aluminum. The sensitivity of this tribostimulated exoemission to anodization parameters and the relation of this emission to oxide cracking is briefly discussed. The emission of neutral species during deformation is presented. The comparison of acoustic emission due to cracking of the anodized oxide layer with the accompanying electron emission shows the intimate link between fracture of the oxide layer and electron emission. We have also studied a model exoemission system (NaCl) to examine the details of the emission mechanisms of neutral species and electrons following perturbations due to electron bombardment. Finally we examine briefly the chemiluminescence that occurs during H3PO4 anodization of Al. GRA

N80-24413# Air Force Materials Lab., Wright-Patterson AFB, Ohio. Nonmetallic Materials Div.
FAILURE MECHANISMS AND INTERPHASE CHEMISTRY OF GOLD FILMS ON Ti6Al4V. PART 1: SURFACE CHEMISTRY OF FAILURE SURFACES Final Report, Jul. 1978 - Oct. 1979
W. L. Baun Jan. 1980 53 p refs
(AF Proj. 2419)
(AD-A081727; AFML-TR-79-4178-Pt-1) Avail: NTIS
HC A04/MF A01 CSCL 11/6

This work is part of a program which looks at the effects of surface treatments on surface chemistry and morphology of titanium alloys with reference to adhesive bonding. Here gold is vapor deposited on Ti6Al4V which was prepared to simulate conditions of etching and aging which might be encountered during processing and use. Although this model system of gold on Ti6Al4V is not a direct analogy to adhesive bonding, certain similarities do exist and the system provides interesting information on bond failure mechanisms. Surface chemical analysis using ISS/SIMS showed that the gold on titanium alloy could model the failure mechanisms on surfaces prepared by methods similar to that in adhesive bonding. ISS/SIMS was found to be a sensitive chemical method to determine locus of failure and the change of composition at interfaces following humid aging and bond testing. Several types of failures appeared to be observed. Fractures which appeared to have occurred by interfacial failure were actually found to be mixed mode failures or failures in a weak boundary layer. GRA

N80-24414# Air Force Materials Lab., Wright-Patterson AFB, Ohio. Nonmetallic Materials Div.
FAILURE MECHANISMS AND INTERPHASE CHEMISTRY OF GOLD FILMS ON Ti6Al4V. PART 2: ETCHING OF Ti6Al4V AND ITS EFFECT ON EVAPORATED GOLD AND CHEMICAL ADHESIVE ADHESION Final Report, Jul. 1978 - Oct. 1979
W. L. Baun Jan. 1980 39 p refs
(AF Proj. 2419)
(AD-A081728; AFML-TR-79-4178-Pt-2) Avail: NTIS
HC A03/MF A01 CSCL 11/6

This work is part of a program which looks at the effects of surface treatments on surface chemistry and morphology of titanium alloys with reference to adhesive bonding. Here gold is vapor deposited on Ti6Al4V which was prepared to simulate conditions of etching and aging which might be encountered during processing and use. Although this model system of gold on Ti6Al4V is not a direct analogy to adhesive bonding, certain similarities do exist and the system provides interesting information on bond failure mechanisms. Surface chemistry changes suggest selective etching of the alpha phase and subsequently larger influence of the alpha phase in bonding. Heating of the gold on Ti6Al4V resulted in improved adhesion, probably by diffusion mechanisms. Exposure to steam resulted in bond degradation in both gold/Ti6Al4V and in adhesive/Ti6Al4V systems. The adhesive bonding results for the etched specimens were compared to expected performance based on 'attachment site' theory. Excellent agreement for both gold on Ti6Al4V and commercial adhesive on Ti6Al4V was observed. Degradation of the bond due to steam followed the same form in both systems. GRA

N80-24415# Polytechnic Inst. of New York. Microwave Research Inst.
MICROWAVE REFLECTIONS FROM VIBRATING IN HOMOGENEOUS CONDUCTING SURFACES Final Report, Jun. 1978 - May 1979
Hellmut J. Juretschke 1980 6 p refs
(Grant AF-AFOSR-3030-78; AF Proj. 2305)
(AD-A081534; AFOSR-80-0133TR) Avail: NTIS
HC A02/MF A01 CSCL 11/6

Homogeneously oxidized iron surfaces show modulated microwave reflections under strain. The effects are too small to account for the modulation found from actual vibrating systems, but are large compared to the response expected from clean metal surfaces. Tunneling junctions of Fe-Oxide-Fe have been investigated as a possible origin of the observed enhancement of strain sensitivity. Such tunneling junctions have been found to exist, at room temperature, but the effect found in model MOM junctions is not large enough to account for the observations. GRA

N80-24418# Georgia Inst. of Tech., Atlanta. School of Physics.
ELECTRONIC EXCITATION STRUCTURE, CORRELATION, AND RELAXATION AND THEIR EFFECTS ON THE OPTICAL PROPERTIES AND ELECTRON EMISSION OF TRANSITION METAL OXIDES Final Report, 1 Oct. 1976 - 30 Sep. 1979
M. W. Ribarsky 30 Nov. 1979 63 p refs
(Grant AF-AFOSR-3108-76; AF Proj. 2301)
(AD-A081946; AFOSR-80-0202TR) Avail: NTIS

HC A04/MF A01 CSCL 07/4

Studies of the electronic excitation structure of transition metal oxides and the effect of the structure on the optical properties, electron correlations, and photoemission spectra of these materials have been made. Techniques have been developed which for the first time allow precise and general calculations of the excitation structure so that in addition to the above properties several other properties can be obtained. These techniques have been applied in particular to calculations on TiO. The calculations allow comparison with experiment and identification of the structure in the optical spectra of oxidized surfaces. They also show that significant correlation and relaxation effects occur in the band structure. GRA

N80-24417# Materials Research Labs., Ascot Vale (Australia).
FRACTURE TOUGHNESS OF FATIGUE-DAMAGED STEEL SPECIMENS
Graham Clark Jun. 1979 20 p refs
(AD-A081841; MRL-R-749) Avail: NTIS HC A02/MF A01 CSCL 11/6

The plane strain fracture toughness K sub Ic of a material is used to describe the crack tip conditions required for unstable growth of a crack, and is used extensively in designing metallic components and in assessing the severity of pre-existing defects. There are many situations in service, however, where the crack tip stress conditions immediately prior to unstable crack growth are not identical to those in a standard fracture toughness test specimen. This report examines the fracture toughness of high-quality gun steel, and describes conditions under which the fatigue pre-cracking levels specified for K sub Ic tests may produce unreasonably high values of K sub Ic, leading to an increased possibility of in-service fracture of components designed using these values. GRA

N80-24418# Air Force Systems Command, Wright-Patterson AFB, Ohio.
HARDENING OF STEEL WITH HIGH-SPEED DEFORMATION IN WIDE TEMPERATURE RANGE
L. I. Mirkin 28 Feb. 1980 27 p refs Transl. into ENGLISH from Fiz. Khim. Obrab. Mater., USSR, no. 1, 1967 p 105-113
(AD-A082325; FTD-ID(RS)T-0231-80) Avail: NTIS HC A03/MF A01 CSCL 11/6

Massive specimens of low-carbon steel 10 (0.1 o/c C) and technical iron (0.06o/o C) were subjected to impact with an indentor at relative speeds in a range of from 1200 to 4000 m/s. Prior to impact, the specimens were heated in a temperature range of up to +700 C and cooled in a temperature as low as -180 C. A number of experiments were also undertaken with specimens at room temperature. Low-temperature (-180 C) deformation of low-carbon steel at impact speeds of 1200 m/s leads to the development of a spherical twin-structure and grain deformation. High-temperature pulsed deformation provides additional recrystallization effects. Increasing the impact speed up to 4000 m/s at room temperature results qualitatively in the same pattern as high-temperature deforming at low speed. The results of X-ray structural analysis and metallographic study of the deformed zone coincide with the dislocation models of shock wave effects on metal. A.R.H.

N80-24419# Battelle Columbus Labs., Ohio.
RESEARCH TO DEVELOP PROCESS MODELS FOR PRODUCING A DUAL PROPERTY TITANIUM ALLOY COMPRESSOR DISK Interim Annual Report, 1 Aug. 1978 - 31 Jul. 1979
G. D. Lahoti and T. Altan Dec. 1979 400 p refs Prepared in cooperation with Wyman-Gordon Co., Worcester, Mass.; Wright State Univ., Dayton, Ohio; Pittsburgh Univ., Pa., Calif. Univ., Berkeley; and Los Alamos Scientific Labs., N. Mex.
(Contract F33615-78-C-5025; AF Proj. 2306)
(AD-A082207; AFML-TR-79-4156) Avail: NTIS HC A17/MF A01

This program is aimed at developing a science-based methodology for analyzing, optimizing, and designing metal-deformation processes to control microstructure and properties in a finished part. The validity and application of this approach will be demonstrated by developing forging process for a compressor disk from Ti-6242 alloy, as an example. GRA

N80-24420# Washington State Univ., Pullman. Dept. of Physics.
SHOCK-INDUCED MARTENSITE REVERSAL IN Fe/30%Ni Final Report, 16 Sep. 1977 - 15 Sep. 1979
George E. Duvall, Paul M. Bellamy, and Ronald J. Livak 14 Feb. 1980 107 p refs
(Grant DAAG29-77-C-0030)
(AD-A082003; ARO-14619.1-MS) Avail: NTIS HC A06/MF A01 CSCL 11/6

It is pointed out that variations of shear stress in a solid undergoing transition may have an important effect on the conditions under which transitions occur. Such variations are not calculable from present knowledge, and for practical reasons, description of the state of shear during the transition must be made part of the constitutive relations. The difficulty of defining a Gibbs energy in a solid is pointed out and the thermodynamic problems are indicated in some details. Experiments are described which promise to reveal the state of shear in the alpha-gamma transition in Fe/30%Ni at high temperatures using shock wave methods. Attempts to carry out these experiments are described, and numerical calculations of phase transitions with and without shear stress show that characteristic shock wave structures do indeed result from various shear conditions during transformation. Transformation experiments at various initial temperatures suggest that there may be a third phase, perhaps epsilon, which is reached in shock experiments for modest driving pressures and for initial temperatures less than 200 C. A description of the metallographic state after shock transition is given. There is minimal evidence that the shear stresses were sharply reduced for initial temperatures of 400 C. GRA

N80-24421# Sussex Univ., Brighton (England). School of Enginsering and Applied Sciences.
SUPERPLASTICITY IN SPLAT-QUENCHED Pb-Sn EUTECTIC
R. Cheese and B. Cantor 1 Jan. 1980 28 p refs
(Grant N00014-78-G-0048)
(AD-A082046; TR-5) Avail: NTIS HC A03/MF A01 CSCL 11/6

Lead-tin eutectic alloy tapes have been prepared by melt-spinning over a wide range of solidification conditions. In all cases, the rapid solidification produces a microstructure consisting of equiaxed lead-rich and tin-rich grains, approximately 4 micron in size. This microstructure could result from a divorced eutectic solidification process, or, more likely, from post-solidification, coarsening. Under tensile loading, the melt-spun lead-tin eutectic tapes exhibit superplastic deformation with large failure strains, a sigmoidal variation of log flow stress with log flow strain, a strain rate sensitivity of approximately 0.42, and an activation energy for superplastic flow of approx. 54KJ mole. GRA

N80-24422# Aluminum Co. of America, Alcoa Center, Pa. Alcoa Technical Center.
FATIGUE RESISTANT ALUMINUM P/M ALLOY DEVELOPMENT Final Technical Report, Sep. 1977 - Sep. 1979
R. E. Sanders, Jr., W. L. Otto, Jr., and R. J. Bucci Wright-Patterson AFB, Ohio AFML Sep. 1979 177 p refs
(Contract F33615-77-C-5174; AF Proj. 2418)
(AD-A081949; Rept-56-79-AF11; AFML-TR-79-4131) Avail: NTIS HC A08/MF A01 CSCL 11/6

An investigation was undertaken to study the effects of fabrication practice, alloy chemistry, aging treatment, and residual stress relief on the fatigue crack growth (FCG) resistance of 7XXX P/M hand forgings and extrusions. Testing was performed in both humid air (R.H.=90%) and salt log atmosphere. FCG rates of the P/M extrusions were slightly higher than those of a 7050-T76511 control material at delta k values below 4 MPa-square root of m. From 4-10 MPa-square root of M, FCG resistance of the P/M extrusions were approximately equivalent to those of the 7050 control. Overaging was beneficial to the FCG resistance of the P/M extrusions. Scatter in the FCG data for the hand forgings prevented any definite conclusions regarding effects of chemistry of aging treatment on crack growth in these materials. FCG testing of stress-relieved and nonstress-relieved forgings showed that compressive residual stresses can markedly affect effective delta K levels and measured FCG rates. The introduction of crack closure concepts to the data analysis

allowed for a computation of effective delta K values to correct for the presence of residual stresses in FCG specimens. GRA

NBO-24423/ Sussex Univ., Brighton (England). School of Engineering and Applied Sciences.
MELT SPINNING OF CRYSTALLINE ALLOYS
S. J. B. Charter, D. R. Mooney, R. Cheese, and B. Cantor 1 Jan. 1980 13 p refs
(Contract N00014-78-C-0048)
(AD-A082052; TR-4) Avail: NTIS HC A02/MF A01 CSCL 11/6

This paper describes the effect of melt-spinning process parameters such as orifice diameter, ejection pressure, and wheel speed, in determining the ribbon dimensions of Pb-Sn eutectic and low content Al alloys. Rapid solidification techniques have been studied ever since the early experiments of Duwez et al. In recent years, the melt-spinning process (sometimes known as chill block casting) has been of particular interest because of the possibility of manufacturing iron-based amorphous alloys for magnetic applications. Liebermann and Graham and Kavesh have discussed the effect of melt spinning process parameters on the dimensions of melt-spun ribbons of amorphous Fe(40)Ni(40)B(20). This note describes the results of an investigation into the effect of melt spinning process parameters on the ribbon dimensions of two other materials, namely Pb-Sn eutectic and Al containing small quantities of Fe and Mn. The main objective was to determine whether the conclusions of Liebermann and Graham and Kavesh can be applied over a wide range of materials. Thus, Pb-Sn and Al-(Fe,Mn) were chosen because they have very different melting points from Fe(40)Ni(40)B(20), and because they solidify in a crystalline rather than amorphous form. GRA

NBO-24424/ Polytechnic Inst. of New York, Brooklyn. Dept. of Physical and Engineering Metallurgy.
CALCULATIONS OF STRESS-STRAIN RELATIONS IN ALPHA-BETA Ti-Mn ALLOYS Annual Technical Report, 1 Apr. 1979 - 5 Feb. 1980
Sreeramamurthy Ankem 5 Feb. 1980 72 p refs
(Contract N00014-75-C-0793; NR Proj. 031-779)
(AD-A082346; TR-2) Avail: NTIS HC A04/MF A01 CSCL 11/6

Elastic interactions at the Widmanstatten alpha-beta titanium alloy interfaces that arise due to compatibility requirements have been calculated for various orientations of the interface with respect to the stress axis. It is shown that maximum interactions are found when the stress axis lies in or close to the interface and 40 degrees away from (0001) alpha beta aids the elastic deformation of alpha much more strongly on the basal slip systems than on either prism or pyramidal slip systems. The significance of these interactions stresses on the initiation of plastic flow is considered. The effect of the interface phase on the elastic interaction stresses has been considered and a possible role of interface stresses on elevated temperature creep of alpha-beta alloys has been suggested. GRA

NBO-24425/ Itek Corp., Lexington, Mass.
SPUTTER DEPOSITION OF DIELECTRIC THIN FILMS Final Report
Ralph E. Aldrich, Salvatore C. Moreno, and Walter J. Faccenda Feb. 1980 24 p
(Contract DAAG29-77-C-0027)
(AD-A082389; ARO-15216.3-P) Avail: NTIS HC A02/MF A01 CSCL 20/3

The work described herein is the outgrowth of a Phase I study completed in August 1978. The objective of the effort is to develop new, high dielectric strength, high optical quality coatings which may ultimately find application in improving the resolution and signal-to-noise ratio of the Pockels Readout Optical Modulator (PROM). During this phase of the program, techniques for rf sputtering SiO2 and Ta2O5 dielectrics and indium tin oxide (ITO) transparent conductors were investigated. These materials were selected as most promising, based on the Phase I study. Test samples were sent to Dr. Armand Tanguay of the University of Southern California for detailed characterization on a parallel program. GRA

NBO-24426/ Naval Research Lab., Washington, D. C. Advanced Materials Technology Branch.
FRACTOGRAPHIC AND MICROSTRUCTURAL ANALYSIS OF SCC SPECIMENS OF HY-100, HY-130, AND HY-180 STEEL WELDMENTS Final Report
Frances W. Fraser and Edward A. Metzbower 10 Jan. 1980 34 p refs
(SF54591500)
(AD-A082301; AD-E000380; NRL-8370) Avail: NTIS HC A03/MF A01 CSCL 13/5

This report summarizes an investigation of the microstructures and fracture morphologies of selected double-V weldments of HY-100, HY-130, and HY-180 steels fractured under stress in an aqueous environment. The specimens, which were prepared using substantially different welding practices and filler materials, displayed similar K sub Iscc values. Optical examination of the microstructures showed that repeated thermal cycling, which occurs during fabrication of GTA (gas-tungsten-arc) fine-bead as-welded specimens, resulted in a uniform, fine-grained, tempered microstructure that offered the greatest resistance to stress-corrosion (SCC). Microvoid coalescence (MVC) was the dominant fracture mode. Coarse-bead, as-welded, GMA (gas-metal-arc) specimens contained substantial amounts of high-temperature-transformation products which fractured by cleavage. Heat treating these specimens, to a lower yield strength, refined the microstructure and improved the SCC resistance. The dominant fracture mode of the heat-treated specimens was MVC. Microbranching of the advancing crack front occurred in the cross-bead, as-welded specimens and may be responsible for the relatively high K sub Iscc values reported. GRA

NBO-24427/ Texas Univ. at Austin. Dept. of Mechanical Engineering and Materials Science and Engineering.
THE INFLUENCE OF HOLD TIMES ON FATIGUE CRACK GROWTH OF ALUMINUM ALLOYS Final Report, 1 Jan. 1976 - Dec. 1979
H. L. Marcus 21 Feb. 1980 107 p refs
(Grant AF-AFOSR-2955-76)
(AD-A082526; AFOSR-80-0233TR) Avail: NTIS HC A06/MF A01 CSCL 11/6

The results of the research on fatigue crack growth in aluminum alloys are described in three general areas. The first relates the influence of hold time at an underload that follows an overload on the fatigue crack growth retardation behavior of the 7075 and 2219 aluminum alloys. A very distinct effect on retardation with hold time is observed. The effect is microstructure dependent with the time dependence behavior extending over a longer period for the high strength materials. This well-defined time dependence clearly shows that lifetime predictions based on accelerated short hold time tests could be very non-conservative. The influence of humidity was also determined using vacuum as a reference environment. The second aspect of the research investigated the nature of the residual displacement, d, that leads to the crack closure phenomena. The last major emphasis was to investigate how gaseous environments interact with fatigue crack growth in aluminum alloys. Combined AES/SIMS studies were made of fracture surfaces taken from fatigue crack growth specimens fatigued in vacuum and subsequently exposed to and fatigued in a range of environments. GRA

NBO-24428/ California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
MECHANICAL PROPERTIES AND MICROSTRUCTURES OF DUAL PHASE STEELS CONTAINING SILICON, ALUMINUM AND MOLYBDENUM M.S. Thesis
T. J. ONeill, Jr. Mar. 1979 107 p refs
(Contract W-7405-eng-48)
(LBL-9047) Avail: NTIS HC A06/MF A01

The heat treatment of duplex ferritic-martensitic low carbon steels containing silicon, aluminum and molybdenum was carried out. Tensile properties of intermediately quenched and directly annealed specimens were characterized and microstructural correlations established. The two-phase mixture rule was used as a fairly good approximation of the mechanical behavior of the duplex system, but it recognized that the properties of both the ferrite and martensite depend on the volume fraction of martensite produced in the final morphology. Thus, although the volume fraction of martensite appears to be the most influential factor in controlling the behavior of the duplex steel, ferrite

strengthening may occur by precipitation hardening and the strength of martensite may increase due to carbon enrichment as its volume fraction is decreased. Utilization of both of these factors results in a composite whose properties do not depend upon the martensite volume fraction (up to about .4). DOE

N80-24429# Sandia Labs., Albuquerque, N. Mex.
THERMAL EXPANSION OF NICKEL TO 2300 K
W. D. Drotning 1979 20 p refs Presented at the 16th Intern. Thermal Conductivity Conf., Chicago, 7 Nov. 1979
(Contracts EY-76-C-04-0789; DE-AC04-76DP-00789)
(SAND-79-1717C; CONF-791134-5) Avail: NTIS HC A02/MF A01

The thermal expansion of nickel was measured from ambient to 2300 K using the gamma attenuation technique. The high temperature measurement system used a high vacuum tungsten mesh furnace designed for passage of a collimated gamma beam through the sample region. The gamma counting system incorporated a thermostatically controlled detector and automatic gain control to achieve count rate stability. A precision analysis is given for the use of the technique to measure changes in molten density as a function of temperature, and a discussion of possible systematic errors in the use of the measurement technique is presented. The linear thermal expansion of solid nickel from ambient to the melting point (1728 K) was observed to be slightly larger than provisional values suggested in the literature. The thermal expansion of molten nickel was measured from melt to 2300 K. DOE

N80-24430# California Univ., Livermore. Lawrence Livermore Lab.
ELECTRICAL DISCHARGE IN GASES: A TECHNIQUE FOR DETECTING METAL ANOMALIES
David E. Lord 6 Jun. 1979 23 p refs
(Contract W-7405-eng-48)
(UCRL-52828) Avail: NTIS HC A02/MF A01

A general technique for inspection of critical parts is presented that is fast, inexpensive, nondestructive, and not limited by size or geometry. Ionization effects that reveal nonuniformities and were recorded with standard photographic equipment are also shown. DOE

N80-24431# Brookhaven National Lab., Upton, N. Y.
SPECIAL ABOUT TRANSITION METALS IN ALLOY PHASE FORMATION
R. E. Watson and L. H. Bennett (NBS, Washington, D.C.) 1979 26 p refs Presented at the AIME Ann. Meeting, New Orleans, 18 Feb. 1979
(Contract EY-76-C-02-0016)
(BNL-27113; CONF-790219-13) Avail: NTIS HC A03/MF A01

Although the bonding properties of d-electrons remain to be completely understood, it is recognized that d band broadening is the dominant term contributing to transition metal cohesion. Less generally realized is that d-band hybridization leads to changes in d-electron counts at a transition metal site which are opposite in sign to the net charge transfer on or off the site. The renormalized atom picture of cohesion of the pure transition metals, the experimental evidence, and the theoretical understanding of d charge transfer going the wrong way are reviewed. A picture of the electronegativity of transition metals based on this trend is developed. Charge transfer associated with equalizing the local chemical potentials in alloys is estimated. Friedel type model alloy calculations are reviewed. The implications of the experimental charge transfer information from Moessbauer isomer shifts to such model alloy calculations and to the strength of the Coulomb energy associated with charge transfer is considered. DOE

N80-24432# National Bureau of Standards, Washington, D.C.
PARAMETERS IN SEMI-EMPIRICAL THEORIES OF ALLOY PHASE FORMATION
L. H. Bennett and R. E. Watson 1979 35 p refs Presented at the AIME Ann. Meeting, New Orleans, 18 Feb. 1979 Prepared in cooperation with Brookhaven National Lab., Upton, NY
(Contract EY-76-C-02-0016)
(BNL-2714; CONF-790219-12) Avail: NTIS HC A03/MF A01

Many theories of alloy solubility, structural stability of compounds, and heats of formation in alloying rely on parameters such as valence, size or electronegativity for their predictions. Nature requires only one parameter, the nuclear charge to completely specify all the electronic properties of the elements. Thus, the atomic parameters are, intimately connected with one another. The physical origins of some of the more popular parameters used are reviewed. The relationship of the different electronegativity scales to each other, and the relationship of electronegativity to other parameters such as atomic size are emphasized. Structural stability maps employing electronegativity and some other parameters are shown for intermetallic compounds formed from different classes of elements: main group-main group, transition metal-main group, and transition metal-transition metal. DOE

N80-24433# Bendix Corp., Kansas City, Mo.
ELECTROMECHANICAL POLISHING OF METAL SPHERES
N. E. Miller and D. E. Engelhaupt Dec. 1979 9 p refs
(Contract EY-76-C-04-0613)
(BDX-613-2311) Avail: NTIS HC A02/MF A01

Equipment was developed to electromechanically polish metal spheres. Mechanical polishing accomplished by the action of three cup-shaped laps which rotate against the sphere. An abrasive slurry containing an electrolyte is continuously applied to the sphere and laps. Electrochemical etching is accomplished by applying a positive potential to two of the laps and a negative potential to the third. DOE

N80-24434# Northwestern Univ., Evanston, Ill.
EFFECT OF POINT DEFECTS ON MECHANICAL PROPERTIES OF METALS Technical Progress Report, 1 Dec. 1979 - 31 Jan. 1980
M. Meshii Jan. 1980 7 p refs
(Contract EY-76-S-02-1367)
(COO-1367-109) Avail: NTIS HC A02/MF A01

The importance of morphological study in conjunction with mechanical tests is emphasized and is explained in niobium, the surface effect on crystal plasticity of niobium, surface film softening in Ni-plated iron, and the hydrogen charging effect in iron. DOE

N80-24435# Westinghouse Research and Development Center, Pittsburgh, Pa.
STUDY TO OPTIMIZE Cr-Mo STEELS TO RESIST HYDROGEN AND TEMPER EMBRITTLEMENT Quarterly Report
B. J. Shaw 7 May 1979 44 p refs
(Contract ET-78-C-01-3050)
(FE-3050-T1; QR-1; QR-2) Avail: NTIS HC A03/MF A01

Two groups of 2-1/4 Cr-1 Mo steel are described with respect to their resistance to temper and hydrogen embrittlement. These include: (1) commercial steels; and (2) laboratory heats with compositions arranged according to a statistical design. This design and the reasoning for the selected compositions is discussed. The test matrix includes two strength levels: that of normal ASTM A387 pressure vessel steel and that representative of the heat affected zone (HAZ) adjacent to a weldment. The characterization of the peak hardness in the HAZ is presented. The test requirements for measuring K/sub Iscc/ in H2S are also included. DOE

N80-24436# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Werkstoff-Forschung.
CORRELATION OF PROCESSING PARAMETERS, MICROSTRUCTURE, AND MECHANICAL PROPERTIES OF HIGH STRENGTH POWDER METALLURGICALLY PRODUCED ALUMINUM ALLOYS Ph.D. Thesis - Technische Hochschule, Aachen
David Voss Nov. 1979 289 p refs
(DFVLR-FB-79-34) Avail: NTIS HC A13/MF A01; DFVLR, Cologne DM 49.70

Two high strength commercial aluminum alloys (2024 and 7075) were produced by powder metallurgy processing. The interrelationship among processing, microstructure, and mechanical properties of these alloys was investigated. Powder metallurgy processing reduces the grain size and the constituent particle size as well as refining the constituent particle distribution. These microstructural changes result in a reduced scattering of the

data and a significant improvement of S-N fatigue properties. These results are discussed in terms of existing knowledge concerning fatigue research, fracture mechanics, and the correlation of mechanical properties and microstructure, particularly the influence of constituent particles and grain size.
Author (ESA)

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N80-24437* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODIFICATION OF THE ELECTRICAL AND OPTICAL PROPERTIES OF POLYMERS Patent
Michael J. Mirtich and James S. Sovey, inventors (to NASA) Issued 22 Apr. 1980 4 p Filed 7 Nov. 1978 Supersedes N70-11216 (17 - 02, p 0164)
(NASA-Case-LEW-13027-1; US-Patent-4,199,650; US-Patent-Appl-SN-958575; US-Patent-Class-428-421; US-Patent-Class-427-38; US-Patent-Class-427-40; US-Patent-Class-427-164; US-Patent-Class-428-474) Avail: US Patent and Trademark Office CSCL 11G

An electron bombardment argon ion source is used to form textured surfaces on polymide and fluorinated ethylene propylene polymers. This treatment improves the optical and electrical properties so that these polymers may be used in industrial and space applications.
Official Gazette of the U.S. Patent and Trademark Office

N80-24438* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
HEAT RESISTANT POLYMERS OF OXIDIZED STYRYLPHOSPHINE Patent
Kazimiera J. L. Paciorek, inventor (to NASA) (Ultrasystems, Inc., Irvine, Calif.) Issued 29 Apr. 1980 14 p Filed 19 May 1978 Supersedes N7825217 (16 - 16 p 2094) Division of US Patent Appl. SN-706424, filed 19 Jul. 1976, US Patent 4, 092, 466 Sponsored by NASA
(NASA-Case-MSC-14903-3; US-Patent-4,200,721; US-Patent-Appl-SN-907479; US-Patent-Class-526-261; US-Patent-Class-525-326; US-Patent-Class-525-336; US-Patent-Class-525-340; US-Patent-Class-525-374; US-Patent-Class-525-375; US-Patent-Class-526-275; US-Patent-Class-526-276; US-Patent-Class-526-278; US-Patent-Class-260-DIG.29; US-Patent-Class-528-481; US-Patent-Appl-SN-706424) Avail: US Patent and Trademark Office CSCL 07C

A flame resistant, nontoxic polymer which may be used safely in confined locations where there is inadequate ventilation is prepared either by polymerizing compounds having the formula R-N=P(C6H5)2(C6H4)CH=CH2 where R is an organic moeity selected from the group of (C6H5)2P(O)-, (C6H5O)2P(O)-, (C6H5)2 C3N3-, or their mixtures, or by reacting a polymer with an organic azide such as diphenylphosphinylazide, diphenylphosphorylazide, 2-azido-4,6-diphenly-5-triazine, 2,4-diazido-6-phenyl-s-triazine, trimethylsilyoazide, triphenylsilylazine, and phenylazine. The reaction of the styrylphosphine with the organozaide results in the oxidation of the trivalent phosphorus atom to the pentavalent state in the form of an unsaturated P=N linkage known as a phosphazene group.
Official Gazette of the U.S. Patent and Trademark Office

N80-24439# Old Dominion Univ., Norfolk, Va.
THE SIGNIFICANCE OF PEEL STRESSES IN CYCLIC DEBONDING M.S. Thesis
Richard A. Everett, Jr. May 1980 116 p refs
Avail: NTIS HC A06/MF A01

Cyclic debonding in an adhesively bonded crack-lap shear specimen is investigated by means of a linear elastic finite element analysis and a series of constant-amplitude axial fatigue tests. The hypothesis that cyclic debonding is due largely to tensile peel stresses in the adhesive is considered. The results indicate that not all of the tensile peel stresses in the adhesive have to be overcome in order to stop cyclic debonding, i.e., a threshold value of the peel stress exists.
M.G.

N80-24440*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
HEAT SEALABLE, FLAME AND ABRASION RESISTANT COATED FABRIC Patent Application
Richard P. Tschirch (Little (Arthur D.), Inc., Cambridge, Mass.) and Kenneth R. Sioman, inventors (to NASA) (Little (Arthur D.), Inc., Cambridge, Mass.) Filed 30 Apr. 1980 17 p
(Contract NAS9-13979)
(NASA-Case-MSC-18382-1; US-Patent-Appl-SN-145107) Avail: NTIS HC A02/MF A01 CSCL 11E

A flexible, lightweight air impermeable coated fabric was developed to replace the flame retardant neoprene coated nylon fabric used as the micrometeorite protection layer in the intravehicular thermomicrometeorite garment. The elastomeric compositions are comprised of thermoplastic polyurethane polymer and flame retarding amounts of a filler selected from decabromodiphenlyoxide and antimony oxide in a 3:1 weight ratio, and decabromodiphenyloxide, antimony oxide, and ammonium polyphosphate in as 3:1:3 weight ratio. The compounds were dissolved at about 40% solids in tetrahydrofuran. Films cast from the solution were dried and bonded to the fabric under heat and pressure at 400 F, 30 psi with 10 sec dwell time. Either heat or dielectric sealing procedures can be used.
NASA

N80-24441*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MICROSTRUCTURAL CHARACTERIZATION OF THE HRSI THERMAL PROTECTION SYSTEM FOR SPACE SHUTTLE
Philip O. Ransone and Donald R. Rummler May 1980 21 p ref
(NASA-TM-81821) Avail: NTIS HC A02/MF A01 CSCL 11B

Components of the space shuttle high temperature reusable surface insulation (HRSI) system were microscopically characterized, both separately and as a system, to obtain information needed for stress analysis models of the thermal protection system. A tension specimen of the HRSI system was loaded in steps and was microscopically observed at each load condition to demonstrate the tension failure mode associated with strain isolation pad (SIP) behavior. A local failure occurred which should be associated with transfer of load through transverse fibers in the SIP. Stress concentrations attributed to the SIP behavior necessitated strengthening of the HRSI by densification of the RSI at the bondline. An HRSI tile was microscopically characterized after the densification process. The densified surface layer blended into the RSI which caused a gradual change in density. The gradation in density does not appear to represent a sharp discontinuity in elastic modulus between the densified layer and the parent material.
J.M.S.

N80-24442# Council for Scientific and Industrial Research, Pretoria (South Africa).
THE CHEMICAL BASIS OF HOTSEALING ADHESIVES FOR INTERFACING
K. H. Stukenbrock 1979 19 p refs Transl. into ENGLISH from Textilveredlung (Switzerland) v. 6, no. 7, 1971 p 459-468
(CSIR-Trans-1452) Avail: NTIS HC A02/MF A01

The process by which hotsealing adhesives are applied to the substrate is briefly described. The methods of application have a certain effect on the selection and quality of the adhesives, at least as far as their external appearance is concerned. The chemical basis of these adhesives is examined.
J.M.S.

N80-24443# Ogden Air Logistics Center, Hill AFB, Utah. Propellant Lab. Section.
QUALIFICATION OF A NEW MAPO SOURCE AND ERL-510 CURING AGENT FOR MINUTEMAN STAGE 1 UF-2121 LINER Semiannual Report
John A. Thompson Jul. 1979 28 p
(AD-A078530; MANCP-419(79)) Avail: NTIS HC A03/MF A01 CSCL 11/4

Thiokol Chemical Corporation/Wasatch Division uses MAPO in the production of UF-2121 liner. Thiokol changed MAPO

vendors and, therefore, qualification of the new source MAPO was required. Thiokol prepared specimens from the new source and also specimens from the original source which are to be used as the control material in the 10 year surveillance testing program. The specimens were transferred to Ogden ALC for testing and reporting of the data obtained. This report includes the test results for the first, second, third, fourth, and fifth time testing of the control and special specimens at Ogden ALC. In all instances, the mean data for the control and special specimens are well above the minimum requirements found in TWR-7857 A, Thiokol specimen data. Therefore, the capability of the liner from the new source material is expected to perform satisfactorily. GRA

N80-24444# Tennessee Univ., Knoxville. Dept. of Polymer Engineering.

RHEO-OPTICS OF SHEAR AND ELONGATIONAL FLOW OF LIQUID CRYSTALLINE POLYMER SOLUTIONS: HYDROXY-PROPYL CELLULOSE/WATER AND POLY-P-PHENYLENE TEREPHTHALAMID/SULFURIC ACID Technical Progress Report, 30 Oct. 1978 - 28 Sep. 1979

Yoshihiko Onogi, James L. White, and John F. Fellers Oct. 1979 63 p refs Submitted for publication

(Contract N00014-77-C-0236; NR Proj. 356-639)

(AD-A077455; PSE-133; TR-05) Avail: NTIS HC A04/MF A01 CSCL 11/9

An experimental study is reported of the quiescent and flow birefringent characteristics of two liquid crystalline polymer solution systems, poly-p-phenylene terephthalamide (PPD-T) in sulfuric acid and hydroxypropyl cellulose (HPC) in water over a range of concentrations. It is shown that, for the quiescent state, the dilute solutions are optically isotropic while the concentrated solutions consist of negatively birefringent domains. During flow at low deformation rates, moving domains are still seen. At higher deformation rates a homogenous highly birefringent fluid is obtained. The birefringence increases with concentration at constant deformation rate and exhibits a major increase as the liquid crystalline state is formed. The source of the birefringence is due to: (1) anisotropy of polarizability of oriented macromolecules, and (2) difference in refractive index of solvent and oriented macromolecules (form birefringence). The results are interpreted in terms of the level of polymer orientation which may be developed in flow for liquid crystalline polymer solutions as compared to solutions of flexible macromolecules. GRA

N80-24445# Pittsburgh Univ., Pa. Dept. of Metallurgical and Materials Engineering.

TOXICITY OF THE DEGRADATION PRODUCTS FROM POLYPHOSPHAZENE COPOLYMERS, PART 4 Interim Report

P. J. Lieu, J. H. Magill, and Y. C. Alarie Dec. 1979 31 p refs Submitted for publication

(Contract N00014-77-C-0310; NR Proj. 356-644)

(AD-A078585; SETEC-MME-79-62; TR-4) Avail: NTIS HC A03/MF A01 CSCL 11/9

Polyphosphazene copolymers have been degraded under dynamic air flow up to temperatures of 700 degrees C at a heating rate of 35 degrees per minute. A few experiments were also conducted up to 1000 C. Animal inhalation screening tests with mice (Swiss Webster) were made under these test conditions. An air flow rate of 20 L/min was employed in the toxicological studies where the temperature in the animal chamber was always held below 45 C, a condition which did not adversely affect the animals under test. Simultaneously, thermogravimetric measurements were made on decomposing polyphosphazenes in order to assess the rate of sample decomposition at different temperatures. Quantitative analytical measurements of the evolution of HCN and CO gases from the polymers (some without fillers) were made under identical thermal and environmental conditions. The results clearly show that there is not a significant correlation between CO-evolved and the induced toxicity in these animals. A similar conclusion follows for the evolution of HCN gas. Correlation with both these gaseous products indicates that other more lethal products may be responsible for the observed LC50 results. The complexity of the decomposition products has not yet been elucidated, but it has been demonstrated clearly that an animal test model properly applied can be used to screen complex polymeric systems. GRA

N80-24446# Pennsylvania State Univ., University Park. Applied Research Lab.

TURBULENCE IN DRAG REDUCING POLYMER SOLUTIONS

I. Kubo Apr. 1979 35 p refs Presented at the Biennial Symp. on Turbulence, Rolla, Mo., 8-10 Oct. 1979

(Contract N00024-79-C-6043)

(AD-A077523; ARL/PSU/TM-79-66) Avail: NTIS HC A03/MF A01 CSCL 11/9

Measurements were made of the mean and fluctuating velocity profile with a Laser Doppler Velocimeter in a fully developed turbulent pipe flow of a polymer drag reducing solution. A one-equation turbulence model has been developed by using a damping factor similar to that of Mizushima and Usui. Predictions by the model agree well with experimental data for the mean velocity profile and for the increase of the length scale in polymer solutions. Predictions are also compatible with the streamwise turbulent intensity measurements and show similar trends to the measured intensity distributions in Newtonian fluids and polymer solutions. In highly reduced drag region, predictions, together with the measurements, indicate considerable effect of Reynolds number below Re = 40,000 on the turbulent intensity profile. GRA

N80-24447# Southwest Research Inst., San Antonio, Tex.

COMPRESSIVE STRENGTH AND DAMAGE MECHANISMS IN CERAMIC MATERIALS Interim Technical Report, 1 Jul. 1979 - 31 Jan. 1980

James Lankford Feb. 1980 23 p refs

(Contract N00014-75-C-0668; NR Proj. 032-553)

(AD-A081657) Avail: NTIS HC A02/MF A01 CSCL 11/2

Compressive strength measurements as a function of temperature and loading rate, and microhardness measurements as a function of temperature, have been carried out for Al2O3, SiC, and Si3N4. Results are correlated in terms of current theories connecting compressive strength, hardness, fracture toughness, and indentation microfracture. It is found that while high loading rates can suppress high temperature intergranular compressive fracture in SiC, this is not true in Al2O3. The threshold crack size for indentation microfracture as a function of temperature seems to correlate at least as well (if not better) with compressive strength as with hardness, and temperature-controlled compressive fracture mechanisms seem to operate during indentation fracture at corresponding temperatures. GRA

N80-24448# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.

THE FEASIBILITY OF ELECTRICAL MONITORING OF RESIN CURE WITH THE CHARGE-FLOW TRANSISTOR Technical Report, Apr. 1978 - Sep. 1979

Stephen D. Senturia, Norman F. Sheppard, Soon Y. Poh, and Howard R. Appelman Dec. 1979 36 p refs Submitted for publication

(Contract N00014-78-C-0591; Grant NSF DMP-76-80895; NR Proj. 356-691)

(AD-A081977; TR-1) Avail: NTIS HC A03/MF A01 CSCL 09/1

A new technique for the electrical monitoring of polymerization reactions such as resin cure is described. The technique is based on the charge-flow transistor, which resembles a conventional MOSFET, but with a portion of the metal gate replaced by the resin under study. Electrical signals obtained from several resins undergoing cure are presented, along with an electrical circuit model that can account for the principal features of these signals. The dramatic change in signal shape during cure can be related to corresponding changes in both the real and imaginary parts of the dielectric constant. GRA

N80-24449# Air Force Materials Lab., Wright-Patterson AFB, Ohio. Nonmetallic Materials Div.

TORSION IMPREGNATED CLOTH ANALYSIS (TICA) OF EPOXY CURE Final Report, Apr. 1977 - Apr. 1978

C. Y. Lee, J. D. Henes, T. E. Grossman, and I. J. Goldfarb Jan. 1980 39 p refs

(AF Proj. 2303)

(AD-A082361; AFML-TR-79-4185) Avail: NTIS HC A03/MF A01 CSCL 11/9

The technique of Torsion Impregnated Cloth Analysis (TICA)

has been developed to allow continuous monitoring of the cure behavior of thermoset systems. Epoxy 3501-A has been used as the material in the feasibility study. The thermal scan of an incompletely cured epoxy specimen has shown that further curing effect during experimentation cannot always be ignored. The cure phase diagram and an isocure state curve have been constructed from the experimental results. Combining both results, it is concluded that an epoxy sample cured at 135 C for 5 hours will have an intrinsic cured glass transition of 158 C. GRA

N80-24450# Southeastern Center for Electrical Education, Inc., Auburn, Ala.

PARTICLE-SIZE ANALYSIS OF ENGINE OILS: A SUPPLEMENT TO SPECTROMETRIC ANALYSIS Final Report, Feb. 1977 - Sep. 1979

James A. Bierlein Wright-Patterson AFB, Ohio AFML Jan. 1980 55 p

(Contract F33615-77-C-5003; AF Proj. 2303)

(AD-A082230; AFML-TR-79-4215) Avail: NTIS HC A04/MF A01 CSCL 11/8

The Spectrometric Oil Analysis Program (SOAP) is a maintenance system used by the Air Force for continuous monitoring of engine oil samples. Total mass concentrations of various metals are measured to provide an indication of engine wear and to warn of impending malfunction; such data provide a basis for scheduling maintenance action in advance of failure. Supplementary methods of analysis are sought with the objective of characterizing oil samples more completely so as to sharpen SOAP decision criteria and achieve improvements in reliability and cost effectiveness. One such technique is particle counting, which defines the size distribution of wear-metal particles and other debris if present. This report describes exploratory work which establishes a methodology for particle-size analysis of authentic engine oils and shows how the data can be applied for practical decision making. Indications are that the engine failure rate can be reduced to about 16% of its current level by supplementing each spectrometric analysis with a particle count. Instrumentation and technique are susceptible to automation which would permit the necessary particle size analysis to be made routinely in a SOAP laboratory within three minutes per sample. An approach to the problems of realizing and exploiting this potential is outlined. GRA

N80-24451# Massachusetts Univ., Amherst. Dept. of Chemistry.

SYNTHESIS AND CHARACTERIZATION OF HIGH ENERGY POLYMERS Final Report, 1 Mar. 1979 - 31 Mar. 1980

James W. Chien and C. Peter Lillya 31 Mar. 1980 16 p refs

(Contract N00014-79-C-0265)

(AD-A082544) Avail: NTIS HC A02/MF A01 CSCL 11/9

Synthetic procedures for selective nitromercuration via phase transfer catalysis have been developed for usage with water insoluble poly(butadiene), poly(isoprene), and carboxyl terminated butadiene acrylonitrile copolymers. GRA

N80-24452# Pennwalt Corp., King of Prussia, Pa. Central Research and Development Dept.

PIEZOELECTRIC POLYMERS Final Report, 1 Jan. 1977 - 31 Dec. 1979

Harry Stefanou Apr. 1980 11 p

(Contract N00014-77-C-0130)

(AD-A083002) Avail: NTIS HC A02/MF A01 CSCL 11/9

The objective of this program was the development of improved fluoropolymer resins for transducer applications. The effort involved synthesis, characterization, and processing of new resins with emphasis on those obtained by copolymerizing vinylidene fluoride (VF2) with monomers such as tetrafluoroethylene (TFE), vinyl fluoride (VF), trifluoroethylene (VF3), and hexafluoropropene (HFP). Variations on the PVF2 homopolymer synthesis were also investigated. In a number of cases, the piezoelectric activity of the copolymers was found to be as good or better than that of the PVF2 homopolymer; however, a distinct advantage of the copolymer vs homopolymer is the fact that, in general, the copolymers are considerably easier to fabricate into thick, oriented film configurations, as needed for underwater use. GRA

N80-24453# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Materials Engineering.

CHEMICAL DURABILITY IMPROVEMENT AND STATIC FATIGUE OF GLASSES Annual Report, 31 Mar. 1979 - 25 Feb. 1980

Minoru Tomozawa 25 Feb. 1980 22 p refs

(Contract N00014-78-C-0315)

(AD-A083007; AR-2) Avail: NTIS HC A02/MF A01 CSCL 11/2

Chemical durability of glass can be improved by applying a coating on the surface. It was also found that an addition of a minor quantity of calcium to the alkaline solution drastically improves the durability of glass. It was confirmed that calcium is deposited on the glass surface and protects the glass. It is suggested that this phenomenon of sorption is playing an important role in the chemical durability of glasses. The strength of glass is strongly influenced by the environment in which it is measured, but the exact cause of the phenomenon is not clear. Mechanical strength of high silica glass was measured in various liquids, as a function of strain rate. At a constant strain rate, the strength of glass measured in various liquid correlated well with the volume change of a high silica porous glass immersed in various liquids. These phenomena in turn showed a good correlation with the surface energy reduction of glass in liquids. These experiments suggest that the surface energy produces the mechanical stress which causes the volume change of porous glass and this stress influences the mechanical strength of glass. GRA

N80-24454# Channel Products Inc., Chesterland, Ohio.

DEVELOPMENT OF SPECIALIZED EQUIPMENT TO MEASURE PEIZOELECTRIC COEFFICIENTS OF POLYMER PIEZOELECTRIC MATERIALS

C. P. Germano 22 Feb. 1980 23 p refs

(Contract N00014-78-C-0383)

(AD-A083013) Avail: NTIS HC A02/MF A01 CSCL 11/4

Specialized equipment has been developed to measure piezoelectric g and d coefficients of polymer piezoelectric materials. It is likely that the same equipment will allow the evaluation of these properties for composite flexible lead titanate zirconates as well. However; samples of these were not made available and thus not tested. By means of a special adaptor, the same equipment may be used as a standard Berlincourt d(33) Meter Channel Prod. Model Number CPDT 3300. GRA

N80-24455# Naval Air Propulsion Test Center, Trenton, N.J. Propulsion Technology and Project Engineering Dept.

DEVELOPMENT OF THE FULL SCALE T63 TEST FOR SPECIFICATION MIL-L-23699 AND XAS-2354 GAS TURBINE LUBRICANTS Final Report

John T. Shimski Feb. 1980 71 p refs

(W45430000; W0598000)

(AD-A082919; NAPC-PE-31) Avail: NTIS HC A04/MF A01 CSCL 11/8

The T56 engine had been utilized for the full scale engine test required under the qualification process for lubricants Specifications MIL-L-23699 and XAS-2354. As advanced engine operating environments become more severe, and the quality of new lubricants improved, the T56 engine became marginal in its ability to thoroughly test gas turbine lubricants. As a result, a new engine was selected through an evaluation of engines in service. The T63-A-5A engine was chosen because of its present level of severity on the turbine section tube wetted parts and its potential for increased severity testing through engine/lube system modification. This report presents the results of engine modifications and operating procedures developed in establishing the T63 engine test for gas turbine lube oil qualification. GRA

N80-24456# California Univ., Livermore. Lawrence Livermore Lab.

STUDY OF THE AGING PROCESSES IN POLYURETHANE ADHESIVES USING THERMAL TREATMENT AND DIFFERENTIAL CALORIMETRIC, DIELECTRIC, AND MECHANICAL TECHNIQUES. 1: IDENTIFYING THE AGING PROCESSES. 2: QUANTIFYING THE AGING EFFECT

L. P. Althouse and N. W. Hetherington 1 Nov. 1979 22 p refs

(Contract W-7405-eng-48)

(UCRL-52849) Avail: NTIS HC A02/MF A01

The thermal aging of polyurethane adhesives was investigated. It is shown that competitive mechanisms are involved that occur simultaneously as a function of time and temperature. These mechanisms involve chain scission and formation of pseudocrystalline domains. DOE

N80-24457# Royal Aircraft Establishment, Farnborough (England).
EFFECT OF TEMPERATURE AND DURATION OF CURE ON THE HEAT DISTORTION TEMPERATURE, JOINT STRENGTH AND DURABILITY OF SOME STRUCTURAL ADHESIVES BONDED TO ALUMINUM
M. H. Stone London HMSO Jul. 1979 23 p refs
(RAE-TM-Mat-318; BR71038) Avail: NTIS HC A02/MF A01

Heat distortion temperatures (Td) were measured for a range of structural adhesives as a function of cure cycle. One-part epoxy adhesives when cured at 120 C gave Td in the range 76 C - 120 C, but could be cured at 90 C to give similar Td. Two-part cold setting epoxies were post-cured in stages at increasing temperature and exhibited Td between 44 C and 100 C. Two acrylate adhesives cured at room temperature gave an apparent Td at about 100 C. Aluminum alloy joints bonded with one-part epoxies could be cured at 90 C, rather than the usual 120 C, without serious loss of strength or durability. Modified cure cycles are proposed as a means of reducing differential thermal contraction stresses in adhesively bonded CERP-metal joints. Author (ESA)

N80-24458# National Technical Information Service, Springfield, Va.
MAGNESIUM OXIDE CERAMICS AND REFRACTORIES. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Jan. 1980
William E. Reed Mar. 1980 262 p Supersedes NTIS/PS-79/0217; NTIS/PS-78/0248; NTIS/PS-77/0207
(PB80-805864; NTIS/PS-79/0217; NTIS/PS-78/0248; NTIS/PS-77/0207) Avail: NTIS HC $30.00/MF $30.00 CSCL 11B

Federally-funded research is cited on the structure, deformation, mechanical properties fabrication, radiation effects tests, and thermodynamic properties. Studies on phase diagrams, diffusion, and electrical, high temperature, and nuclear reactor applications are also presented. This updated bibliography contains 255 abstracts, 20 of which are new entries to the previous edition. GRA

N80-24459# National Technical Information Service, Springfield, Va.
MAGNESIUM OXIDE CERAMICS AND REFRACTORIES, VOLUME 3. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1978 - Jan 1980
William E. Reed Mar. 1980 156 p Supersedes NTIS/PS-79/0219; NTIS/PS-78/0249; NTIS/PS-77/0208
(PB80-805872; NTIS/PS-79/0219; NTIS/PS-78/0249; NTIS/PS-77/0208) Avail: NTIS HC $30.00/MF $30.00 CSCL 11B

Worldwide research is cited on sintering, structure, mechanical properties, stength, degradation, phase studies, additives, and use of these materials. This updated bibliography contains 149 abstracts, 67 of which are new entries to the previous edition. GRA

N80-24460# Southern Services, Inc., Birmingham, Ala.
RESIDUAL MONOMERS IN ACRYLIC AND MODACRYLIC FIBERS AND FABRICS Final Report
Joe M. Finkel, Ruby H. James, and Herbert C. Miller Jul. 1979 14 p refs
(Contract EPA-68-01-4746)
(PB80-129166; SORI-EAS-79-504; EPA-560/11-80-003) Avail: NTIS HC A02/MF A01 CSCL 06J

The detection and quantitation of acrylonitrile, vinylidene chloride, and vinyl bromide, which are used as monomers in the production of acrylic and modacrylic fibers were surveyed. The amounts of monomers evolved from samples of carpets, fibers, and fabrics at 50 C and 50% relative humidity were determined by gas chromatography with a flame ionization detector and by direct insertion probe mass spectroscopy. The results of the gas chromatographic studies indicate that detectable amounts of residual acrylonitrile, vinylidene chloride, and vinyl bromide are not released from the carpet, fiber, and fiber samples under the conditions selected for analysis. Direct insertion mass spectrometry indicated that methyl bromide evolves from all of the fiber samples and from two of the three carpet samples. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N80-24461 Minnesota Univ., Minneapolis.
A ONE-STEP EFFUSIONAL PROCESS FOR PRODUCING HYDROGEN AND OXYGEN FROM WATER USING SOLAR ENERGY Ph.D. Thesis
Richard Boyer Diver 1979 196 p
Avail: Univ. Microfilms Order No. 8011793

A process for producing hydrogen and oxygen from water involves heating water to high temperatures (2400 - 3000 K)by a concentrating solar collector. At those temperatures water dissociates into a mixture which contains primarily six species. The lighter species, H and H2 are to be separated from the mixture by a one-step effusional separation technique. In principle the limiting thermal efficiency of such a thermochemical process is the Carnot efficiency. In practice, thermal efficiency is also limited by the irreversibilities associated with the various internal processes. To determine the magnitudes and sources of irreversibilities, an analytical model of an archetypal device for using solar energy in a one-step thermochemical process for producing hydrogen and oxygen from water is presented and analyzed. The rate of entropy production associated with each of the major components is calculated and related to the operating variables. On the basis of that analysis, improvements in the model are suggested and evaluated. In addition irreversibilities which are a consequence of economic or other compromises are anticipated and also evaluated. Dissert. Abstr.

N80-24462# Canada Inst. for Scientific and Technical Information, Ottawa (Ontario).
NONISOTHERMAL EXPERIMENTS ON THE HYDRODESULPHURIZATION OF COAL
H. Baumann, J. Klein, and H. Juentgen 1980 22 p refs Transl. into ENGLISH from Erdoel Kohle, Petrochem. (West Germany), v. 30, no. 4, 1977 p 159-164
(NRC/CNR-TT-1963; ISSN-0077-5606) Avail: NTIS HC A02/MF A01

The hydrodesulfurization of bituminous coal by nonisothermal pyrolysis in an atmosphere of hydrogen was investigated. The rate of formation of hydrogen sulfide when samples were heated at a constant rate was plotted as a function of temperature. The curves divide into three regions: one to about 500 C, and the HS formed results from organically bound sulfur; the second is between 500 and 600 C, and the HS is due to the decomposition of pyrites into FeS; the third region extends from 600 to 1000 C, and the HS is due to organically bound sulfur, and the reduction of FeS. It is concluded that for low rank coals, moderate temperatures are sufficient for removal of most of the organic sulfur. F.O.S.

N80-24463# Southwest Research Inst., San Antonio, Tex.
RESTORING ESSENTIAL FLOW AND IGNITION PROPERTIES TO ANTIMISTING KEROSINE (AMK) FOR TURBINE AIRCRAFT OPERATIONS Final Report, 26 Apr. 1978 - 31 Jan. 1979
R. J. Mannheimer Feb. 1979 32 p refs Sponsored in part by DOT
(Contract DAAK70-78-C-0001)
(AD-A081684; MED105; FAA-RD-79-62) Avail: NTIS HC A03/MF A01 CSCL 21/4

A small scale test was used to measure the resistance of a fuel to form a mist that will support flame propagation. Preliminary results indicate that this measurement is in good agreement with other large scale fire safety tests. The ignition resistance

of antimisting kerosine (AMK) was found to depend on fuel properties such as aromatic content and the presence of polar additives. The most controversial result is that in addition to improving filterability, surfactants increase the ignition resistance of AMK. While the rheological mechanism for this was established, several factors suggest that it is associated with improved solubility of the polymer. R.C.T.

N80-24464*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
COAL DESULFURIZATION BY LOW TEMPERATURE CHLORINOLYSIS, PHASE 2 Final Report
J. J. Kalvinskas, Karel Grohmann, Naresh Rohatgi, John Ernest, and Don Feller 15 Jan. 1980 146 p
(Contracts NAS7-100; ET-N-I-019060)
(NASA-CR-163152; JPL-Pub-80-15) Avail: NTIS HC A07/MF A01 CSCL 21D

An engineering scale reactor system was constructed and operated for the evaluation of five high sulfur bituminous coals obtained from Kentucky, Ohio, and Illinois. Forty-four test runs were conducted under conditions of 100 by 200 mesh coal, solvents - methylchloroform and water, 60 to 130 C, 0 to 60 psig, 45 to 90 minutes, and gaseous chlorine flow rate of up to 24 SCFH. Sulfur removals demonstrated for the five coals were: maximum total sulfur removal of 46 to 89% (4 of 5 coals with methylchloroform) and 0 to 24% with water. In addition, an integrated continuous flow mini-pilot plant was designed and constructed for a nominal coal rate of 2 kilograms/hour which will be operated as part of the follow-on program. Equipment flow sheets and design drawings are included for both the batch and continuous flow mini-pilot plants. J.M.S.

N80-24465*# Technology Development Corp., Huntsville, Ala.
COAL CONVERSION PRODUCTS INDUSTRIAL APPLICATIONS
Joseph H. Dunkin and Dennis Warren 28 Feb. 1980 213 p
(Contract NAS8-33759)
(NASA-CR-161469; TDC-80-005) Avail: NTIS HC A10/MF A01 CSCL 21D

Coal-based synthetic fuels complexes under development consideration by NASA/MSFC will produce large quantities of synthetic fuels, primarily medium BTU gas, which could be sold commercially to industries located in South Central Tennessee and Northern Alabama. The complexes would be modular in construction, and subsequent modules may produce liquid fuels or fuels for electric power production. Current and projected industries in the two states which have a propensity for utilizing coal-based synthetic fuels were identified, and a data base was compiled to support MFSC activities. A.R.H.

N80-24466# Politecnico di Milano (Italy). Inst. di Macchine.
THE DYNAMICS OF SOLID PROPELLANT COMBUSTION Annual Technical Report, 31 Dec. 1977 - 30 Nov. 1979
Luigi DeLuca, Aldo Coghe, and Aldolfo Reggiori Sep. 1979 199 p refs
(Grant DA-ERO-78-G-029; DA Proj. 1T1-61102-BH-57)
(AD-A082881; ATR-2) Avail: NTIS HC A09/MF A01 CSCL 21/9

A nonlinear stability analysis of solid rocket propellant burning was carried out, within the framework of a thermal theory for thin (quasi-steady gas phase) heterogeneous flames. This required an integral method in reducing the partial differential equation for the condensed phase heat conduction to an approximate ordinary differential equation. A nonlinear algebraic function, called static restoring function, was found that contains all basic properties of equilibrium and stability of burning solid propellants. GRA

N80-24467# Badger Plants, Inc., Cambridge, Mass.
CONCEPTUAL DESIGN OF A COAL-TO-METHANOL-TO-GASOLINE COMMERCIAL PLANT, VOLUME 1 Final Report, 31 Aug. 1977 - 1 Mar. 1979
Mar. 1979 311 p refs
(Contract EX-76-C-01-2416)
(FE-2416-43-Vol-1) Avail: NTIS HC A14/MF A01

An engineering and economic assessment of the conceptual design for an integrated commercial facility to convert coal-to-methanol-to-gasoline was investigated. The process steps involved an oxygen blown, high pressure coal gasification technique, followed by a chemical shift reaction, acid gas removal, sulfur recovery, methanol synthesis, methanol conversion, gas fractionation, and HF alkylation. DOE

N80-24468# Badger Plants, Inc., Cambridge, Mass.
CONCEPTUAL DESIGN OF A COAL-TO-METHANOL-TO-GASOLINE COMMERCIAL PLANT. VOLUME 2: COMMERCIAL PLANT ECONOMIC ANALYSIS Final Report, 31 Aug. 1977 - 1 Mar. 1979
Mar. 1979 322 p refs
(Contract EX-76-C-01-2416)
(FE-2416-43-Vol-2) Avail: NTIS HC A14/MF A01

The economic aspects of the coal-to-methanol-to-gasoline project are presented. Capital and product costs are specifically addressed. DOE

N80-24469# Badger Plants, Inc., Cambridge, Mass.
CONCEPTUAL DESIGN OF A COAL-TO-METHANOL-TO-GASOLINE COMMERCIAL PLANT. VOLUME 4A: DRAWINGS, SPECIFICATIONS, AND ALTERNATE DESIGNS Final Report, 31 Aug. 1977 - 1 Mar. 1979
Mar. 1979 504 p
(Contract EX-76-C-01-2416)
(FE-2416-43-Vol-4A) Avail: NTIS HC A22/MF A01

Block flow diagrams, utility flow diagrams, and the one line electrical diagrams pertaining to the base case coal-to-gasoline commercial plant are presented. Mass balance figures for the main process units are tabulated. Components and totals are shown for major process streams. The duty specifications and sketches for the major equipment items and buildings comprising the facility are presented. The conceptual and mechanical design features of the slag gasifier are also presented. R.C.T.

N80-24470# Badger Plants, Inc., Cambridge, Mass.
CONCEPTUAL DESIGN OF A COAL-TO-METHANOL-TO-GASOLINE COMMERCIAL PLANT. VOLUME 4B: DRAWINGS, SPECIFICATIONS, AND ALTERNATE DESIGNS Final Report, 31 Aug. 1977 - 1 Mar. 1979
Mar. 1979 459 p
(Contract EX-76-C-01-2416)
(FE-2416-43-Vol-4B) Avail: NTIS HC A24/MF A01

The conceptual designs for a coal gasifier are discussed. The following alternating coal gasifier concepts are described: slag bath; gas velocity in gasifier; carbon gasifier per pass; carbon gasifier overall; gasifier diameter; and number of gasifiers. R.C.T.

N80-24471# Oak Ridge National Lab., Tenn. Chemical Technology Div.
EVALUATION OF AN IN SITU COAL GASIFICATION FACILITY FOR PRODUCING M-GASOLINE VIA METHANOL
W. C. Ulrich, M. S. Edwards, and R. Salmon Dec. 1979 250 p refs
(Contract W-7405-eng-26)
(ORNL-5439) Avail: NTIS HC A11/MF A01

A conceptual process design and cost estimate was formulated for a facility producing approximately 15,000 barrels of M-gasoline per day via methanol from synthesis gas generated by gasification of coal in situ. The design was based on experimental data and mathematical predictions on the linked vertical well in situ coal gasification process. In place coal consumption is 20,000 tons/day, based on a subbituminous Wyoming coal. The capital investment was estimated to $535 million in first-quarter 1978 dollars. M-gasoline product price was calculated as a function of the debt/equity ratio, annual earning rates on debt and equity, inplace coal cost, and plant factor (onstream efficiency). Using a debt/equity ratio of 70/30, and interest rate on debt of 9%, an after tax earning rate on equity of 15%, an inplace coal cost of $5/ton, an LPG (propane) by-product credit of $410 to the 6th power Btu, and a plant factor of 90%, the product price of M-gasoline is approximately $0.90/gal at the plant gate. Calculated overall efficiency for the facility was 22%, based on inplace coal. DOE

N80-24472# Argonne National Lab., Ill.
METHANE FROM LANDFILLS
R. E. Zimmerman and M. L. Wilkey 1979 13 p refs Presented

at the 2nd Ann. Conf. of Appl. Res. and Practice on Municipal and Ind. Waste, Madison, Wis., 18 Sep. 1979
(Contract W-31-109-eng-38)
(CONF-790999-1) Avail: NTIS HC A02/MF A01

The recovery, processing, and utilization technology operational in the landfill methane recovery field are described. The status of the US Department of Energy's Landfill Gas Utilization research and development program are also described. DOE

N80-24473# Midwest Research Inst., Golden, Colo.
THE 3RD ANNUAL BIOMASS ENERGY SYSTEMS CONFERENCE PROCEEDINGS
John T. Pfeffer Oct. 1979 625 p refs Conf. held at Golden, Colo., 5-7 Jun. 1979
(Contract EG-77-C-01-4042)
(SERI/TP-33-285) Avail: NTIS HC A99/MF A01

The latest research finding from federally funded and other selected projects in the clean fuels for biomass field were reviewed. The engineering and economic status of the biomass energy system was summarized. Problems related to ongoing research are identified and discussed and opportunities for on future research are explored. R.C.T.

N80-24474# Illinois Univ., Urbana. Dept. of Civil Engineering.
BIOLOGICAL CONVERSION OF BIOMASS TO METHANE CORN STOVER STUDIES Progress Report, 1 Dec. 1977 - 1 Aug. 1978
John T. Pfeffer and Gerald E. Quindry Jun. 1979 171 p refs
(Contract EY-76-S-02-2917)
(COO-2917-13; UILU-ENG-79-2004) Avail: NTIS HC A08/MF A01

A series of experiments was conducted to determine the performance characteristics of the methane fermentation process using corn stover processed through four parallel fermenters each having a capacity of 775 liters. A continuous feed system was employed to determine the conversion efficiency. The dewatering characteristics of the effluents and the quality of the liquid and solid residues were determined. The biodegradability of corn stover is low. Data obtained at a fermentation temperature of 59 + -1 C show that only 36 percent of the volatile solids are biodegradable. Pretreatment with caustic (NaOH) concentration of 0.30 molar and a temperature of 115 C for one hour increased the biodegradable fraction to 71 percent of the volatile solids. The reactor slurries were easily dewatered by both vacuum filtration and centrifugation. Corn stover does not appear to be attractive economically at the present energy prices. DOE

N80-24475# Battelle Columbus Labs., Ohio.
CARBOHYDRATE CROPS AS A RENEWABLE RESOURCE FOR FUELS PRODUCTION. VOLUME 2: IDENTIFICATION OF KEY POLICY ISSUES, ALTERNATIVES, AND IMPLICATIONS RELATING ENERGY FROM BIOMASS
D. A. Scantland, T. A. McClure, and E. S. Lipinsky 30 May 1979 75 p refs
(Contract W-7405-eng-92)
(BMI-2031-Vol-2) Avail: NTIS HC A04/MF A01

Significant quantities of ethanol from carbohydrate crops could be produced from the equivalent number of dollars currently diverted and expected to be spent under the Food and Agriculture Act of 1977; however the the production of ethanol from sugar crops or corn would mean that significant changes in the prices of agricultural products could be expected (all other things being equal). In the initial development of ethanol fuels, ethanol from corn appears to be the least expensive as compared to sugarcane, sugar beets, and sweet sorghum. This is primarily because of high by-product credits. The crop with the greatest long term potential is sweet sorghum. Various policy incentive programs will continue to be directed towards stimulating biomass energy production. Four policy incentive programs are described. DOE

N80-24476# Pennsylvania State Univ., University Park. Coal Research Station.
CHARACTERISTICS OF AMERICAN COALS IN RELATION TO THEIR CONVERSION INTO CLEAN ENERGY FUELS Quarterly Technical Progress Report, Jul. - Sep. 1978
W. Spackman, A. Davis, P. L. Walker, H. L. Lovell, F. J. Vastola, P. H. Given, N. H. Suhr, and R. G. Jenkins May 1979 83 p refs
(Contract EX-76-C-01-2030)
(FE-2030-13) Avail: NTIS HC A05/MF A01

Certain important aspects of the chemical and physical composition of American lignite coals were characterized. Differential scanning calorimetry and thermogravimetric analysis were used to study the interaction between oxygen and seventeen coal chars (40 x 100 mesh) at 100 C. The same techniques were used to investigate briefly the interaction between air and a highly caking coal at selected isothermal temperatures in the range 100 to 275 C. DOE

N80-24477# Midwest Research Inst., Golden, Colo.
PHOTOBIOLOGICAL HYDROGEN PRODUCTION
M. Seibert, S. Lien, and P. F. Weaver 1979 20 p refs Presented at the US/USSR Joint Working Group in Microbiol., Riga, 2-5 Oct. 1979
(Contract EG-77-C-01-4042)
(SERI/TP-33-410) Avail: NTIS HC A02/MF A01

Hydrogen production by phototrophic organisms, which has been known since the 1930's, occurs at the expense of light energy and electron-donating substrates. Three classes of organisms, namely, photosynthetic bacteria cyanobacteria, and algae carry out this function. The primary hydrogen-producing enzyme systems, hydrogenase and nitrogenase, are discussed along with the manner in which they couple to light-driven electron transport. In addition, the feasibility of using in vivo and in vitro photobiological hydrogen producing systems in future solar energy conversion applications are examined. DOE

N80-24478# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
FUEL FROM FARMS: A GUIDE TO SMALL-SCALE ETHANOL PRODUCTION
Feb. 1980 165 p refs
(Contract EG-77-C-01-4042)
(SERI/SP-451-519) Avail: NTIS HC A08/MF A01

A guide on fermentation processes with emphasis on small-scale production of ethanol using farm crops as a source of raw material is published. The status of on-farm ethanol production as well as an overview of some of the technical and economic factors is presented. Decision and planning worksheets and a sample business plan for use in decision making are included. Specifics in production including information on the raw materials, systems components, and operational requirements are also provided. Diagrams of fermentors and distilling apparatus are included. DOE

N80-24479# Department of Energy, Washington, D. C.
COAL CONVERSION COMPARISONS, TASK 002 Final Report
K. A. Rogers and R. F. Hill Jul. 1979 99 p refs
(Contract EF-77-C-01-2468)
(FE-2468-51) Avail: NTIS HC A05/MF A01

Technologies for producing synthetic fuels from coal are examined. The conclusion is made that many processes are ready for commercial demonstration but synthetic fuel will cost more than conventional petroleum fuels. An economic comparison method was developed to reflect the value differences of the different fuel products. The value method assigns relative values to all producing from a multiproduct synfuel process. This method incorporates the preferences of the marketplace to arrive at the necessary selling prices for each product. Two methods of financing, using typical utility and private venture returns on investment, are included for all products. The fourteen conversion processes studied are divided into six groups: solid clean fuel, direct liquefaction, indirect liquefaction, synthetic natural gas, industrial gas, and electric power from a combined cycle-integrated gasifier system. Three of the processes are shown in an alternate mode of operations giving a total of seventeen sets of energy costs. The prediction is made that no major technological advances are expected which will significantly decrease synfuel costs. DOE

N80-24480# Department of Energy, Washington, D. C. Coal Conversion Div.
COAL LIQUEFACTION Quarterly Report, Oct. - Dec. 1978
Sep. 1979 61 p refs
(Contract EX-76-C-01-2297)

(DOE/ET-0068/4) Avail: NTIS HC A04/MF A01

The conversion of coal to liquid fuels is discussed with emphasis on improved process configurations for both catalytic processes. The advantage of coal liquefication is assessed with respect to its high yield of a wide range of liquid products, especially boiler fuels, distillate fuel oil, and gasoline. The development of several conversion processes are briefly described. DOE

N80-24481# Department of Energy, Washington, D. C. Fossil Fuel Processing Div.

COAL CONVERSION Technical Report, 1978

Sep. 1979 188 p refs

(Contract EX-76-C-01-2297)

(DOE/ET-0081/2) Avail: NTIS HC A09/MF A01

Development of processes for converting coal into products that substitute for those derived from oil and natural gas is considered with emphasis on rapid commercialization. These substitute fuels include crude oil, fuel oil and distillates, chemical feedstocks, pipeline quality and fuel gas, and other products such as char that may be useful in energy production. J.M.S.

N80-24482# Chevron Research Co., Richmond, Calif.

REFINING AND UPGRADING OF SYNFUELS FROM COAL AND OIL SHALES BY ADVANCED CATALYTIC PROCESSES Quarterly Report, Jul. - Sep. 1979

R. F. Sullivan and D. J. ORear Oct. 1979 44 p

(Contract EX-76-C-01-2315)

(FE-2315-43) Avail: NTIS HC A03/MF A01

The denitrification fouling rate of ICR 106 catalyst was measured in an accelerated fouling rate test. At comparable conditions, the H-coal whole process product is denitrified to a greater extent than the solvent-refined coal 2 whole process product. Deposits were formed in the preheater of the whole oil hydrotreater, which appear to be from either asphaltenes of soluble iron compounds in the feed. An alumina guard bed ahead of the catalyst sucessfully removed these contaminants. A large batch of low aromatic, denitrified H-coal whole process product was prepared for downstream hydrocracking. In this preparation hydrogen was consumed by the oil at roughly 2100 SCF/bbl. The whole product from this hydrotreater was than cracked in an extinction recycle hydrocracker to make a 350 F product. In this hydrocracking step, hydrogen was consumed by the oil 800 SCF/bbl. DOE

N80-24483# Brookhaven National Lab., Upton, N. Y. Energy Storage and Conversion Div.

BULK HYDROGEN STORAGE USING METAL HYDRIDES

G. Strickland and M. J. Russo, Jr. Dec. 1979 10 p refs Presented at the 2nd Miami Intern. Conf. on Alternative Energy Sources, Miami Beach, Fla., 10-13 Dec. 1979

(Contract EY-76-C-02-0016)

(BNL-27083; CONF-791204-14) Avail: NTIS HC A02/MF A01

The considerations involved in design and use of a process unit, or reservoir, for storing bulk quantities of hydrogen via solid particles of titanium-iron-maganese are described along with several applications. One style of reservoir having improved design features, and the service system in which it was installed for testing are discussed. The reservoir has a nominal storage capacity of 50 lb (23 kg) of hydrogen and is rated for hydrogen charging and discharging times in the 5 to 10 hour range. DOE

N80-24484# Argonne National Lab., Ill. Materials Science Div.

MATERIALS TECHNOLOGY FOR COAL-CONVERSION PROCESSES Quarterly Report, Apr. - Jun. 1979

Nov. 1979 70 p refs

(Contract W-31-109-eng-38)

(ANL-79-93; QR-18) Avail: NTIS HC A04/MF A01

A 500-h test run, exposing 11 water-cooled refractions to basic slag (B/A = 1.5), was completed. High chromia content and high density again appeared to be significant factors contributing to the corrosion resistance of refractories used for slag containment. A literature review on high temperature ultrasonic coupling was completed and suggest that studies on long term (month to years) pressure-coupling stability are needed. Flow-induced acoustic energy studies (relevant to acoustic leak detection) suggest that a 20% coal-water slurry flowing through an orifice under pressure produces acoustic-energy excitation mainly at frequencies < 65 kHz and that a better correlation between acoustic runs levels and flow rate is obtained as the differential pressure is increased. Corrosion studies of type 310 stainless steel at 1000 C with various P/sub O2/ and P/sub/S2/ suggested that titanium addition increases the corrosion rate relative to that of commercially available steels. DOE

N80-24485# Argonne National Lab., Ill.

METHANE RECOVERY FROM URBAN REFUSE

M. L. Wilkey and R. Eric Zimmerman 1979 8 p Presented at the 2nd World Energy Eng. Conf., Atlanta, 28 Oct. 1979

(Contract W-31-109-eng-38)

(CONF-7910105-2) Avail: NTIS HC A02/MF A01

The goals of the methane recovery program are discussed. Major emphasis is placed on the develop, evaluation and implementation of the technologies necessary for recovery, processing, and utilization of combustible gases generated in landfills. To achieve these goals, a research program that examined the feasibility of landfill gas recovery and use, as well as future optimization techniques and methods, has been undertaken.DOE

N80-24486# Argonne National Lab., Ill.

REFUSE CONVERSION TO METHANE (REFCOM): A PROOF-OF-CONCEPT ANAEROBIC DIGESTION FACILITY

D. K. Walter and Caroline Brooks 1979 7 p refs Presented at the Joint Power Generation Conf., Charlotte, N.C., 7 Oct. 1979 Prepared in cooperation with DOE, Washington, D.C. and Mittelhauser Corp., Downers Grove, Ill.

(Contract W-31-109-eng-38)

(CONF-791006-2) Avail: NTIS HC A02/MF A01

A process for the anaerobic digestion of solid waste and sewage sludge into methane is described. Known as RefCOM (Refuse Conversion to Methane), the DOE experimental facility in Florida can process 100 tons of raw refuse per day with an output as high as 700,000 cubic feet of gas (CH4 and CO2) per day. Based on an average home gas consumption of one million cubic feet per year, a 1,000 tons-per-day plant has the potential to meet the gas needs of over 7,000 homes. The objectives of the RefCOM experiment are to: establish information on the quality and quantity of gas produced; ascertain optimum operating parameters for both mesophilic and thermophilic modes; and evaluate the reliability of the techniques. DOE

N80-24487# Los Alamos Scientific Lab., N. Mex.

CATALYTIC COAL CONVERSION SUPPORT: USE OF LASER FLASH-PYROLYSIS FOR STRUCTURAL ANALYSIS Progress Report, 1 May - 31 Aug. 1979

N. E. Vanderborgh, W. J. Verzino, Jr., and B. A. Nichols Nov. 1979 47 p refs

(Contract W-7405-eng-36)

(LA-8133-PR) Avail: NTIS HC A03/MF A01

The project plan for determining the structural changes occurring in coal, using laser pyrolysis are delineated. The pertinent, computer generated references are appended. The determination of trial heating regimes and the selection and collection of appropriate catalysts are reported. DOE

N80-24488# Montana State Univ., Bozeman.

CATALYTIC HYDROGENATION FOR COAL-DERIVED LIQUIDS Interim Report, Jun. - Aug., 1979

L. Berg and F. P. McCandless Sep. 1979 43 p

(Contract EY-76-C-01-2034)

(FE-2034-16) Avail: NTIS HC A03/MF A01

The catalysts specifically designed to hydrodenitrogenate solvent refined coal continue. Using catalyst bases of specific surface area, pore volume and pore diameter and impregnating them with tungsten, nickel, cobalt and/or molybdenum yielded denitrogenation of SRC from 1.17% nitrogen to as low as 0.01% nitrogen after 45 minutes use and 0.1% nitrogen after 90 minutes, and desulfurization of SRC from 0.73% to as low as 0.2% sulfur after three hours. The catalysts appear to be a cross between hydrotreating and hydrocracking catalysts and will require a burn-off and resulfiding after four to six hours of operation. Five additional catalysts were discovered which appear to offer the possibility of an economically attractive process for converting

solvent-refined coal into a feedstock suitable for a conventional petroleum refinery. DOE

N80-24488# California Univ., Livermore. Lawrence Livermore Lab.
MATERIALS PROBLEMS IN PRODUCTION, TRANSPORT, AND STORAGE OF HYDROGEN
O. H. Krikorian 2 Jan. 1980 13 p refs Presented to the Energy-Sources Technol. Conf. and Exhibition, New Orleans, 3-7 Feb. 1980
(Contract W-7405-eng-48)
(UCRL-83771) Avail: NTIS HC A02/MF A01

Materials problems in three hydrogen production methods and in the transport and storage of hydrogen are identified. In hydrogen production by thermochemical cycles, materials problems center primarily around an H2SO1 boiler, and H2SO4 vapor decomposer, and an HI decomposer. In advanced electrolytic hydrogen production, the main thrust has been to raise cell efficiencies by raising operating temperatures and pressures using two approaches: (1) an alkaline electrolyte cell; and (2) a solid polymer electrolyte cell. In high temperature stream electrolysis, materials problems include development of solid state electrolytes for oxide ion conduction, and electrically conductive anode, cathode and interconnecting materials for cells. Problems dealing with pipeline steels for transport of gaseous hydrogen are also considered. Long term storage of hydrogen on a large scale is anticipated to be in underground repositories. However for short term or small scale uses, hydrogen storage in hydrides, or storage in glass microballons offer certain operational advantages. DOE

N80-24490# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
LBL CONTINUOUS BIOMASS LIQUEFACTION PROCESS ENGINEERING UNIT (PEU)
Carlos Figueroa, Jim Wrathall, and Sabri Ergun Nov. 1979 6 p ref Presented at the Thermochem. Conversion Contractors' Meeting, Rolla, Mo., 7 Nov. 1979
(Contract W-7405-eng-48)
(LBL-10082; CONF-791166-2) Avail: NTIS HC A02/MF A01

Project goals and preliminary tests of a biomass liquefaction process engineering unit are briefly described. Findings from slurry pumping capability tests indicate that hydrolyzed slurries of 20 percent can be pumped without any difficulties. A schematic for the process engineering unit is given. M.G.

N80-24491# Los Alamos Scientific Lab., N. Mex.
LASL THERMOCHEMICAL HYDROGEN Status Report, 20 Sep. 1979
K. E. Cox 1979 5 p Presented at the DOE Chem. Energy Storage and Hydrogen Energy Systems Contracts Rev. Meeting, Reston, Va., 12 Nov. 1979
(Contract W-7405-eng-36)
(LA-UR-79-2799; CONF-791127-1) Avail: NTIS HC A02/MF A01

A conceptual design of the hybrid bismuth sulfate cycle and experimental work to verify the design conditions were examined. Key findings were a 50.8% efficiency was obtained when an improved cycle design was coupled to a fusion energy source at 1500 K; experimental results showed an endothermic heat requirement of +172 kJ/mol for the decomposition of Bi2O3.2SO3 to Bi2O3.SO3, and SO3; reaction times for bismuth sulfate decomposition were determined as a function of temperature. At 1240 K, < 1.5 min were required for the first two stages of decomposition from Bi2O3.3SO3 to Bi2O3; tests made to determine the feasibility of decomposing Bi2O3.2SO3 in a 1 inch diameter rotary kiln showed that Bi2O3.2SO3 could be decomposed continuously. DOE

N80-24492# Louisiana State Univ. and A&M Coll., Baton Rouge. Agricultural Experiment Station.
POTENTIAL OF PRODUCING AND HARVESTING SUGARCANE AND SWEET SORGHUM AS A RENEWABLE BIOMASS ENERGY RESOURCE Annual Report
B. J. Cochran and Ray Ricaud 31 Jul. 1979 64 p
(Grant EG-77-G-05-5373)
(ORO-5373-T1) Avail: NTIS HC A04/MF A01

Manufacturers of land clearing equipment, land leveling, ditching machinery, mold board plows, and lister plows are listed as well as manufacturers of sugar cane tillage equipment. Suppliers are also listed for the following types of equipment: planting, irrigation, spraying equipment, aerial application spraying and dusting equipment, power units, harvesting, loaders, and transport units. Methods of mechanical harvesting sugarcane and sweet sorghum grown from improved planting and production treatments are evaluated. Commercial mechanical systems available for harvesting maximum sugarcane biomass in the sugar production areas of the United States are described. DOE

N80-24493# Midwest Research Inst., Golden, Colo.
ENVIRONMENTAL AND INSTITUTIONAL CONSIDERATIONS IN THE DEVELOPMENT AND IMPLEMENTATION OF BIOMASS ENERGY TECHNOLOGIES
Charlotte Schwab Sep. 1979 46 p refs
(Contract EG-77-C-01-4042)
(SERI/TR-62-264) Avail: NTIS HC A03/MF A01

The photosynthetic energy stored in plant and organic waste materials in the United States amounts to approximately 40% of the nation's total energy consumption. The conversion of the biomass energy source, in the form of biomass residues and wastes, can create problems. Environmental impacts may be significant, and legal responses to these impacts are a key determinant to the widespread adoption of biomass technologies. The major legal areas which will impact on biomass energy conversion include (1) the effect of existing state and federal legislation; (2) the role of regulatory agencies in the development of biomass energy; (3) governmental incentives to biomass development; and (4) legal issues surrounding the functioning of the technologies themselves. Emphasis is placed on the near-term technologies whose environmental impacts and institutional limitations are more readily identified. If biomass energy is to begin to achieve its apparently great potential, these questions must receive immediate attention. DOE

N80-24494# Garrett Energy Research and Engineering Co., Ojai, Calif.
INVESTIGATION OF WOODY BIOMASS SPECIES FOR FUEL PRODUCTION IN WARM CLIMATE, NON-AGRICULTURAL LAND IRRIGATED BY BRACKISH OR SALINE WATER Final Report, 24 Apr. 1978 - 24 Apr. 1979
D. E. Garrett 24 Apr. 1979 209 p refs
(Contract ET-78-C-01-3077)
(DSE-3077-T1) Avail: NTIS HC A10/MF A01

Over 17,000 Tamarisk plants were grown in an approximately 1.5 acre plot of very poor soil in the San Joaquin Valley at Hanford, California. Tamarix aphylla (Athel Tree) cuttings were tested in a variable fertilization and water salinity statistically designed standard agronomic program. Other variables were studied with potted T. aphylla, T. pentandra (Salt Cedar), T. hispida and T. africana on a semi-quantitative basis. The plants averaged about 0.4 inches of growth per day from planting in May until growth stopped in November, and produced a dry weight yield for this short season of about 7.4 dry tons/acre/year assuming an 18 inch spacing. The average yield for the better plots was 14 DTE/acre/yr. Nitrogen fertilizer increased growth by about 38% at a level of 300 Kg/ha. Water containing 600 to 35,000 ppM salts did not change the growth rate appreciallby. DOE

N80-24495# Sandia Labs., Livermore, Calif. Solar Programs Dept.
OVERALL EFFICIENCIES FOR CONVERSION OF SOLAR ENERGY TO A CHEMICAL FUEL
J. D. Fish 1979 22 p refs Presented at the 2nd Miami Intern. Conf. on Alternative Energy Sources, Miami Beach, Fla., 10 Dec. 1979
(Contracts EY-76-C-04-0789; DE-AC04-76DP-00789)
(SAND-79-8636; CONF-791204-9) Avail: NTIS HC A02/MF A01

A complete and consistent schema for determining the overall efficiency of a generalized process for the conversion of solar energy into a chemical fuel was developed and applied to seven conversion processes. The overall efficiency of each of these processes is determined by ten common factors: maximum theoretical efficiency; inherent absorption losses; inherent internal losses; rate limiting effects; reflection losses; transmission losses;

coverage losses; system construction requirements; parasitic losses; and harvesting and conversion losses. DOE

N80-24496# Sandia Labs., Livermore, Calif. Materials Development Div.

TECHNOLOGIES AND ECONOMICS OF SMALL-SCALE HYDROGEN STORAGE

S. L. Robinson and J. J. Iannucci Dec. 1979 51 p refs

(Contract EY-76-C-04-0789)

(SAND-79-8646) Avail: NTIS HC A04/MF A01

Presently available fixed-site hydrogen storage technologies are examined, to identify the minimum cost storage technique for various combinations of quantity, cycling frequency and parasitic energy costs. Pressurized gas, cryogenic liquid, hydride, and microballoon storage are studied. For each form, installed capital cost, filling and emptying equipment costs and parasitic energy costs are developed and parameterized by electric rates. The energy intensive systems are economical for long term cycling (seasonal storage) but unfavorable for short term (daily cycling). Low pressure gas storage is favored for short term and intermediate term storage. Development of microballoon storage is recommended as a possible low cost long term storage option. DOE

N80-24497# California Univ., Livermore. Lawrence Livermore Lab.

HYDROGEN ENCAPSULATION IN A CS-EXCHANGED TYPE 4A ZEOLITE

P. L. Turi and J. F. Lakner 24 Sep. 1979 12 p refs

(Contract W-7405-eng-48)

(UCRL-52865) Avail: NTIS HC A02/MF A01

Hydrogen encapsulation in a Cs-exchanged synthetic type 4A zeolite was observed. Hydrogen storage capacity was measured in samples in which Na(+) yields Cs(+) exchange was from 19 to 61%. The samples were loaded with H2 at temperatures from 350 to 420 C, at pressures up to 20,000 psi. Results are reported. DOE

N80-24498# TRW, Inc., McLean, Va. Energy Systems Planning Div.

COAL DERIVED FUEL GASES FOR MOLTEN CARBONATE FUEL CELLS

Nov. 1979 91 p

(Contract EY-77-C-21-8085)

(METC-8085-T2) Avail: NTIS HC A05/MF A01

The range of raw gas compositions available from the major classes of coal gasifiers, the degree of gas clean-up achievable with state-of-the-art and future gas clean-up systems, and the energy penalties associated with gas clean-up are described. The results indicate that gasifer product raw-gas compositions are influenced by the gasifer type, operating conditions and coal type. Fixed-bed gasifers, that do not subject the coal pyrolysis products to temperatures above approximately 1600 F, contain significant quantities of tars, oils, organic sulfur compounds and organic nitrogen compounds in the product raw gas. Fluid-bed, entrained-bed, and molten salt gasifers that operate at higher temperature, produce less of these materials. Increasing operating temperature also favors the formation of H2 and CO as compared to CO2, H20 and CH4. Since the presence of H2 and CO is preferred over CH4 for a molten carbonate fuel cell feed, high operating temperature seem to be indicated for gasifiers operating with molten carbonate fuel cells. DOE

N80-24499# Johns-Manville Sales Corp., Denver, Colo.

FILTRATION PROCESS AND EQUIPMENT STUDIES FOR COAL LIQUEFACTION PROCESSES Final Report

I. Bastidas, R. C. Himes, F. B. Hutto, and P. Martin May 1979 217 p refs

(Contract EX-76-C-01-2007)

(FE-2007-T1) Avail: NTIS HC A10/MF A01

A rotary pressure precoat filter test leaf was designed and constructed which makes it possible to simulate the operation of a full scale rotary pressure precoat filter. Variables affecting the operation of the rotary pressure precoat filter were investigated in detail. Precoat filtration principles were also reviewed. The effect of filtration variables as determined by studies with the rotary pressure precoat filter test leaf is discussed. DOE

N80-24500# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.

MARINE BIOMASS SYSTEM: ANAEROBIC DIGESTION AND PRODUCTION OF METHANE

K. F. Haven, Mark Henriquez, and Ronald L. Ritschard Apr. 1979 84 p refs

(Contract W-7405-eng-48)

(LBL-8460) Avail: NTIS HC A05/MF A01

Two approaches to kelp conversion to methane are described. First, a large (10.56 sq mi) oceanic farm using an artificial substrate and an upwelling system to deliver nutrient-rich deep ocean water to the kelp bed is described. This system can yield as much as 50 tons of kelp (dry ash free - DAF) per acre-year. Kelp are harvested by a specially designed 30,000 DWT ship and delivered to an onshore processing plant as a ground kelp slurry. The second system involves the use of a natural coastal kelp bed. Growth rates in this bed are stimulated by a nutrient rich sewer outfall. A conceptual model is presented for calculations of the growth rate of kelp in this natural bed which can reach 15 tons (DAF) per acre-year. The harvest activity and processing plant are similar to those for oceanic farm system. The overall concept of kelp production and conversion to methane is discussed. The general design of the ocean farm system is presented. DOE

N80-24501# Eyring Research Inst., Provo, Utah.

EXPERIMENTAL AND PROCESS DESIGN STUDY OF A HIGH RATE ENTRAINED COAL GASIFICATION PROCESS Final Report, Jan. 1974 - Nov. 1978

M. J. McIntosh and Ralph L. Caotes 1978 415 p refs

(Contract EX-76-C-01-1548)

(FE-1548-T2) Avail: NTIS HC A18/MF A01

Work began in January 1974. The original experimental equipment was designed, fabricated and installed during the first eight months of the project. A total of 298 test runs were made for a total of 800 operating hours. Cold gas efficiencies of 73 percent at specific gasification rates of 115 pounds coal/hour cu ft atmospheres were achieved. Extensive equipment modifications were made to overcome problems encountered. An extended series of runs on a range of feed coals and char were conducted. Using the results a semi-emperical mathematical model was developed. This model incorporated material and energy balances, assumption of frozen water gas shift equilibrium and Arrhenius correlations of carbon gasification and methane formation. The Arrhenius constants were found to depend directly on the carbon percentages and the percent volatile matter for the four coals tested. Mathematical models of the entrained gasifier integrated in various ways with a combined cycle system were developed and used to study the effect of mode of integration, coal type, gasifier heat loss and gasifier steam feed rate on combined cycle performance. DOE

N80-24502# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

BIOTECHNOLOGY FOR PRODUCING FUELS AND CHEMICALS FROM BIOMASS: RECOMMENDATIONS FOR RESEARCH AND DEVELOPMENT VOLUME 1. SYNOPSIS AND EXECUTIVE SUMMARY

Ruxton Villet Dec. 1979 29 p 2 Vol.

(Contract EG-77-C-01-4042)

(SERI/TR-332-360-Vol-1) Avail: NTIS HC A03/MF A01

Areas of research and development judged to be crucial for establishing a biotechnology of biomass processing are identified. Two general avenues are recommended for R and D: (1) in the near term, revival of the older fermentation technology and improvement of processing efficiencies; and (2) in the longer term, the development of novel biotechnological processes, such as for the conversion of lignocellulosic biomass to fuels and chemicals. Recommended R and D ranges from work in molecular genetics to biochemical engineering aspects of plant design. It is recommended that the R and D strategy be designed as an integration of three disciplines: biochemical engineering, microbial genetics, and biochemistry. Applications of gene-transfer methodology and developments in continuous fermentation should be pursued. Currently, economic incentive for the use of biological conversion processes is marginal. However, as the imported fraction of US oil supply grows and hydrocarbon costs mount, the market is beginning to motivate a quest for substitutes. DOE

N80-24503# National Transportation Policy Study Commission, Washington, D. C.
UTILIZATION CONCERNS OF POTENTIAL TRANSPORTATION FUELS
Gretchen Coar Apr. 1979 43 p refs
(PB80-138498; NTPSC/WP-79-37) Avail: NTIS HC A03/MF A01 CSCL 10A

The known utilization problems for fuels which were identified as likely near and midterm alternatives to petroleum (synthetics from oil shale and coal, and alcohols from various sources) are identified and discussed. The focus is on distribution and handling, material compatibility, vehicle performance, fuel economy, environmental effects, safety and toxicity, and potential utilization in alternative engines. GRA

N80-24504# NEUS, Inc., Santa Monica, Calif.
BIOSOURCES DIGEST. A JOURNAL ON BIOMASS UTILIZATION, VOLUME 1, NUMBER 3
Harry Sobel Jul. 1979 65 p refs
(Grant NSF PFR-77-12500)
(PB80-139306; NSF/RA-790296) Avail: NTIS HC A04/MF A01 CSCL 10A

A rubber analysis procedure is described which publicizes laboratory p r ,ctions and details for pilot plant operations along with a discuss-on on gasohol production. Four eggshaped digesters being constructed by the City of Los Angeles are also discribed. Multi-use oil and hydrocarbon-producing crops in adaptive systems for food, material and energy production are briefly examined. Patents pertinent to biomass utilizattion, sources of new available information, are listed. GRA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N80-24505# Naval Civil Engineering Lab., Port Hueneme, Calif.
PERFORMANCE OF UNCOATED AND COATED NONFERROUS HEAT EXCHANGERS IN A TEMPERATE MARINE ENVIRONMENT FOR TWO YEARS Final Report, Jul. 1975 - Aug. 1978
T. Roe, Jr., J. F. Jenkins, and R. L. Alumbaugh Aug. 1979 64 p refs
(YF53534006)
(AD-A081154; CEL-TN-1560) Avail: NTIS HC A04/MF A01 CSCL 13/1

Twelve finned tube heat exchangers - four pieces of three different materials or material combinations were operated in a marine environment: (1) uncoated; (2) coated with an electrostatically applied polyester enamel; (3) coated with a specification alkyd system; or (4) coated with a zinc inorganic silicate material. Temperature drops across each exchanger were monitored for 24 months and heat transfer capacities were calculated for selected periods. Copper tube/copperfin exchangers coated with any of the three different coating systems were superior in thermal efficiency to the uncoated units. The opposite was true for the all aluminum units and for the copper tube/aluminum fin units. Based on 1978 prices, coating of copper tube/copper fin exchangers increases their cost from 48 to 60%. It is believed this can be justified on the basis of increased life expectancy alone. GRA

N80-24506# Fondazione Ugo Bordoni, Rome (Italy).
A REFLECTOMETER FOR THE CONTROL OF THE DEPOSITION OF THIN FILMS [RIFLETTOMETRO DI CONTROLLO PER DEPOSIZIONI DI STRATI SOTTILI]
Ludovico Muzii Dec. 1978 18 p In ITALIAN
(FUB-34-1978) Avail: NTIS HC A02/MF A01

A reflectometric device for the control of thickness of metallic or dielectric thin layer deposits is described. The apparatus can measure the reflectance at several wave lengths and has high sensitivity even for low reflectance films. The implementation of the optical detector, the control and measuring circuits and the design of the optical system are discussed. The effect of secondary reflection is analyzed. Author (ESA)

N80-24507# National Bureau of Standards, Washington, D.C. Electroosystems Div.
MEASUREMENTS ON INSULATING MATERIALS AT CRYOGENIC TEMPERATURES Final Report
William E. Anderson and Richard S. Davis Jan. 1980 165 p refs Prepared for Brookhaven National Lab., Upton, N.Y.
(Contract EA-77-A-01-6010)
(PB80-134596; NBSIR-79-1950) Avail: NTIS HC A08/MF A01 CSCL 09A

Results of a four-year effort to study the high voltage dielectric behavior of various materials at cryogenic temperatures are described. Dissipation factors at 60 Hz were measured for polymer tapes and epoxy samples at 4.2 K, atmospheric pressure. Multi-layer polymer samples in coaxial geometries at temperatures from 7 K to 10 K and helium pressures up to 1.5 megapascals were also studied. The measurements were performed at stresses up to 40 MV/m. Since partial discharges were major source of losses at the higher stresses and their presence was possibly detrimental to the integrity of the insulation, instrumentation was developed and implemented to study these discharges under conditions found in proposed ac superconducting power-transmission lines. GRA

N80-24508# Southwest Research Inst., San Antonio, Tex.
SURFACE PREPARATION OF PAVEMENTS PRIOR TO APPLICATION OF PAVEMENT MARKINGS Final Report
John M. Dale Jan. 1980 23 p
(Contract DOT-FH-11-9298)
(PB80-137326; FHWA-TS-80-207) Avail: NTIS HC A02/MF A01 CSCL 13B

A brush assembly was designed, fabricated and installed on a Texas Department of Highways and Public Transportation striping truck and run over a variety of roads. It was found that brushing did not significantly extend the service life of the traffic marking paint. There was not sufficient improvement to consider mounting brush assemblies ahead of the spray guns on striping trucks for use on a daily basis. GRA

N80-24509# Office of Personnel Management, Washington, D.C. Personnel Research and Development Center.
THE NEED FOR A COMMON METRIC IN ITEM BIAS STUDIES Final Report
Neil J. Dorans Sep. 1979 18 p refs
(PB80-128671; TM-79/20) Avail: NTIS HC A02/MF A01 CSCL 12A

A common metric is essential for valid comparisons in any investigations of subpopulation differences and similarities. Item bias studies are one type of investigation that focuses on testing for subpopulation differences. The techniques of latent trait theory, with its powerful property of item parameter invariance are applied to the item bias question. The property of item parameter invariance is examined, with primary consideration given to the importance of metric in studies that test for item bias by testing for item parameter invariance. Neutral, hypothetical examples illustrate some consequences of ignoring the importance of metric. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N80-24510* National Aeronautics and Space Administration. Pasadena Office, Calif.
METHOD AND APPARATUS FOR DOPPLER FREQUENCY MODULATION OF RADIATION Patent
Jack S. Margolis (JPL), Daniel J. McCleese (JPL), Michael S. Shumate (JPL), and Clay H. Seaman, inventors (to NASA) (JPL) Issued 6 May 1980 6 p Filed 3 Nov. 1978 Supersedes N80-21141 (18 - 11 p 1493) Sponsored by NASA
(NASA-Case-NPO-14524-1; NASA-Case-NPO-14527-1; US-Patent-4,201,468; US-Patent-Appl-SN-957452; US-Patent-Class-358-28.5; US-Patent-Class-350-6.5;

US-Patent-Class-350-6.6; US-Patent-Class-350-294) Avail: US Patent and Trademark Office CSCL 20N

A method and apparatus are described for frequency modulating radiation, such as from a laser, for optoacoustic detectors, interferometers, heterodyne spectrometers, and similar devices. Two oppositely reciprocating cats-eye retroreflectors are used to Doppler modulate the radiation. By reciprocally moving both retroreflectors, the center of mass is maintained constant to permit smooth operation at many Hertz. By slightly offsetting the axis of one retroreflector relative to the other, multiple passes of a light beam may be achieved for greater Doppler shifts with the same reciprocating motion of the retroreflectors.

Official Gazette of the U.S. Patent and Trademark Office

N80-24511*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

CAVITY-BACKED, MICRO-STRIP DIPOLE ANTENNA ARRAY Patent Application

Haynes Ellis, Jr., inventor (to NASA) (Rockwell Intern. Corp., Downey, Calif.) Filed 30 Apr. 1980 15 p

(Contract NAS9-14000)

(NASA-Case-MSC-18606-1; US-Patent-Appl-SN-145206) Avail: NTIS HC A02/MF A01 CSCL 09E

A flush mounted, microwave band antenna for high performance aircraft and space vehicles is disclosed. Features of the cavity-backed microstrip antenna include: (1) low cost construction; (2) microstrip elements in orthogonal dipole arrangement; and (3) circular polarized sum and difference radiation patterns. The microstrip antenna elements are fed through quadrature hybrids proceeded by a comparator hybrid. J.M.S.

N80-24512*# Texas Univ. at Austin. Electrical Engineering Research Lab.

ATS-6 ASCENDING: NEAR HORIZON MEASUREMENTS OVER WATER AT 30 GHz

W. J. Vogel, A. W. Straiton, and B. M. Fannin Apr. 1977 30 p refs Presented at URSI Comm. of Open Symp. on Propagation in Nonionized Media, LaBaule, France, 28 Apr. - 6 May 1977

(Contract NAS5-22576)

(NASA-CR-159966) Avail: NTIS HC A03/MF A01 CSCL 20N

The return of the ATS 6 satellite to a western longitude during the fall of 1976 presented a unique opportunity to perform low angle of elevation measurements at 30 GHz. For this purpose a receiver using a 1.5 m antenna was set up at Port Aransas, Texas, resulting in a propagation path entirely over water. The 30 GHz beacon was monitored daily for at least one hour from 8 September 1976 to 21 September 1976. During the time the elevation angle changed from 1.5 deg to 17.3 deg, the mean attenuation decreased from 20 dB to 2 dB and the standard deviation from over 6 dB to less than .2 dB. The deep fades at angles below 4 deg show significantly sharper nulls than peaks on a log scale. Spectra of the log amplitude fluctuations vary as the (-8/3) power of the spectral frequency in the limit. A flattening is noticeable at the low frequencies. A precipitation event at 8.5 deg elevation produced a 16 dB fade and significantly increased the variance. Author

N80-24513*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

RADIO PROPAGATION THROUGH SOLAR AND OTHER EXTRATERRESTRIAL IONIZED MEDIA

Ernest K. Smith and Robert E. Edelson 15 Jan. 1980 66 p refs

(Contract NAS7-100)

(NASA-CR-163153; JPL-Pub-79-117) Avail: NTIS HC A04/MF A01 CSCL 20N

The present S- and X-band communications needs in deep space are addressed to illustrate the aspects which are affected by propagation through extraterrestrial plasmas. The magnitude, critical threshold, and frequency dependence of some eight propagation effects for an S-band propagation path passing within 4 solar radii of the Sun are described. The theory and observation of propagation in extraterrestrial plasmas are discussed and the various plasma states along a near solar propagation path are illustrated. Classical magnetoionic theory (cold anisotropic plasma) is examined for its applicability to the path in question. The characteristics of the plasma states found along the path are summarized and the errors in some of the standard approximations are indicated. Models of extraterrestrial plasmas are included. Modeling the electron density in the solar corona and solar wind, is emphasized but some cursory information on the terrestrial planets plus Jupiters is included. J.M.S.

N80-24514*# Mitre Corp., Bedford, Mass.

ON-BOARD PROCESSING CONCEPTS FOR FUTURE SATELLITE COMMUNICATIONS SYSTEMS

William T. Brandon, ed. and Brian E. White, ed. May 1980 39 p refs

(Contract F19628-80-C-0001)

(NASA-CR-159683; MTR-3943) Avail: NTIS HC A03/MF A01 CSCL 17B

The initial definition of on-board processing for an advanced satellite communications system to service domestic markets in the 1990's is discussed. An exemplar system with both RF on-board switching and demodulation/remodulation baseband processing is used to identify important issues related to system implementation, cost, and technology development. Analyses of spectrum-efficient modulation, coding, and system control techniques are summarized. Implementations for an RF switch and baseband processor are described. Among the major conclusions listed is the need for high gain satellites capable of handling tens of simultaneous beams for the efficient reuse of the 2.5 GHz 30/20 frequency band. Several scanning beams are recommended in addition to the fixed beams. Low power solid state 20 GHz GaAs FET power amplifiers in the 5W range and a general purpose digital baseband processor with gigahertz logic speeds and megabits of memory are also recommended. A.R.H.

N80-24515*# Tennessee Univ., Knoxville. Systems and Radar Lab.

SPS ANTENNA POINTING CONTROL

James C. Hung 29 Feb. 1980 84 p refs

(Contract NAS8-33604)

(NASA-CR-161446) Avail: NTIS HC A05/MF A01 CSCL 13I

The pointing control of a microwave antenna of the Satellite Power System was investigated emphasizing: (1) the SPS antenna pointing error sensing method; (2) a rigid body pointing control design; and (3) approaches for modeling the flexible body characteristics of the solar collector. Accuracy requirements for the antenna pointing control consist of a mechanical pointing control accuracy of three arc-minutes and an electronic phased array pointing accuracy of three arc-seconds. Results based on the factors considered in current analysis, show that the three arc-minute overall pointing control accuracy can be achieved in practice. J.M.S.

N80-24516# Communications Research Centre, Ottawa (Ontario). Radio and Radar Research Branch.

RANGE ESTIMATION FROM WAVE-FRONT CURVATURE

R. V. Webber Mar. 1979 32 p refs

(AD-A081640; CRC-1322) Avail: NTIS HC A03/MF A01 CSCL 20/14

The computation of the range of a signal from its wavefront curvature has been investigated. Some success was obtained by fitting a truncated power series to phase data which was taken by a linear array of antenna. In simulated experiments the effect of noise in the data was investigated extensively. For typical data obtained with the Communications Research Centre HFDF 1.2 km array, one should be able to make useful estimates of range for distances up to about 100 kilometers. In a field experiment the ground wave was used to estimate ranges of up to 111 kilometers. The bias and the rms deviation from the mean range were low for the near transmission sites but were up to 33% and 45% respectively, for the more remote sites. An unsuccessful attempt was made to compute the range of a signal which had been reflected by the E layer of the ionosphere. In this case the range was about twice the useful limit for the present system and the received signal may well have consisted of two or more interfering rays. Because of distorted wavefronts resulting from wave interference the range cannot be computed for a resultant signal which is made up of two or more signals which come from almost the same direction. GRA

N80-24517# Raytheon Co., Sudbury, Mass. Equipment Development Labs.
DIGITAL TRANSMISSION SYSTEM Final Technical Report, 10 Mar. 1976 - Feb. 1978
Manfred Unkauf, Paul Danis, and Carl Alsmeyer Griffiss AFB, N.Y. RADC Oct. 1979 212 p refs
(Contract F30602-76-C-0217; AF Proj. 2157)
(AD-A080894; RADC-TR-79-250) Avail: NTIS HC A10/MF A01 CSCL 09/2

The objective of this program was to improve the performance of an earlier experimental model by replacing existing circuit card assemblies with new circuits that would enhance the performance of the DAR-IV technique. Therefore, emphasis of the DTS program was to implement improvements in the basic design which included increased memory of the demodulator coherent filter, modification of the clock recovery loop for increased stability, improvement in bit count integrity and modification of the adaptive equalizer associated with increasing demodulator coherent filter memory. Digital transmission was accomplished at data rates of 1.75, 3.5 and 7.0 Mbps by using the Distortion Adaptive Receiver (DAR-IV) modulation/demodulation (modem) technique. Testing of the DAR-IV was performed using the RADC troposcatter media simulator and the actual over-the-air tests on the AN/TRC-97 and AN/TRC-132 on the RADC Troposcatter Experimental Range in Rome, New York and on NATO Strategic Troposcatter (ACE-HIGH) links between Dosso Dei Galli, Italy and Feldberg and Kinsbach, Germany as part of the combined US/NATO digital troposcatter Test Program. The test results show that the DAR-IV technique has the potential to provide quality digital data transmission on both tactical and strategic troposcatter links. The DAR-IV was shown to typically operate within 2 dB of theoretical in back-to-back tests. GRA

N80-24518# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PREDICTION AND BUFFERING OF DIGITAL SPEECH STREAMS FOR IMPROVED TASI PERFORMANCE ON A DEMAND-ASSIGNED SATELLITE CHANNEL
William Kantrowitz, Clifford J. Weinstein, and Edward M. Horstetter 15 Nov. 1979 46 p refs
(Contract F19628-80-C-0002)
(AD-A081593; TN-1979-75; ESD-TR-79-249) Avail: NTIS HC A03/MF A01 CSCL 17/2

An approach for achieving efficient TASI-like multiplexing of speech on a demand-assigned satellite channel, where a number of ground stations each support a small number of off-hook callers, is proposed and evaluated. The approach presupposes a demand-assignment scheme which allows rapid changes in channel capacity assignments, and includes channel reservation requests based on speaker activity prediction, and buffering of speech at the nodes to increase multiplexing efficiency. System performance results obtained by computer simulation indicate potentially significant reductions in speech cutout fraction and accompanying increases in system TASI advantage. GRA

N80-24519# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE TERRAIN SHIELDING ALGORITHM USED IN THE MASR AIRBORNE SURVEILLANCE RADAR PROGRAM
Philip L. Fleck 3 Dec. 1979 32 p refs
(Contract F19628-80-C-0002; AF Proj. 2217)
(AD-A081409; TN-1979-69; ESD-TR-79-276) Avail: NTIS HC A03/MF A01 CSCL 17/9

The algorithm described herein quickly determines if a point on the surface of the earth is visible or not from a remote aircraft due to masking by nearby terrain features. It was designed to work in an airborne radar surveillance system, updating a 16 x 16 km area every 4 seconds with a resolution of 250 x 250 m. GRA

N80-24520# Lincoln Lab., Mass. Inst. of Tech., Lexington.
FACTORS AFFECTING THE PERFORMANCE OF ADAPTIVE ANTENNA SYSTEMS AND SOME EVALUATION TECHNIQUES
Joseph T. Mayhan and Franklin W. Floyd 9 Aug. 1979 107 p refs
(Contract F19628-78-C-0002; AF Proj. 2029)
(AD-A081711; TN-1979-14; ESD-TR-79-197) Avail: NTIS HC A06/MF A01 CSCL 09/5

The basic performance of an adaptive antenna system is influenced somewhat independently by two sub-systems: the antenna and the adaptive processor. Choice of the antenna type (multiple beam antenna or phased array) and the design of the adaptive processor (which is used to control the weighting at each antenna feed port) depends strongly on the specific requirement of a particular system. To date, much has been published on the ideal performance characteristics of adaptive nulling antenna systems. However, little has been published on the effects of hardware component imperfections on system performance. To characterize these effects is the purpose of this note. We present methods for categorizing, analyzing and measuring the effects of a few of the key components which are common to the majority of adaptive systems implemented to date. Some examples we will discuss are those effects due to antenna type, antenna tolerance errors, channel tracking errors, weighting circuits, hard-limiters, correlators and base-band components. We analyze these from the viewpoint of the degree of cancellation achievable by the adaptive processor and also their impact on loop dynamics (where appropriate). In order to illustrate the various effects, measured performance results obtained using an experimental Applebaum-Howell type adaptive processor will be presented. GRA

N80-24521# Stanford Univ., Calif.
RESEARCH ON LARGE ADAPTIVE ARRAYS Final Technical Report, Aug. 1978 - Jun. 1979
B. Widrow, R. Chestek, H. Mesiwala, and K. Duvall Griffiss AFB, N.Y. RADC Dec. 1979 111 p refs
(Contracts F30602-78-C-0083; N00019-78-C-0276; AF Proj. 2305)
(AD-A081388; RADC-TR-79-308) Avail: NTIS HC A06/MF A01 CSCL 09/5

Most adaptive filters are designed to achieve minimization of estimation error. Other design goals could include satisfaction of constraints as well as minimization of mean square error. The paper proposes a particular set of performance criteria, involving 'soft constraints'. A 'soft-constraint lms algorithm' is derived from a performance function which is the sum of mean square error and weighted squared constraint violation errors. The soft constraint algorithm is applied to adpative antenna arrays as an example, which includes a demonstration of the effects of varying the softness of the constraints. Also, convergence properties of the algorithm are presented. A relation between the output power of a signal from a converged soft constraint lms adaptive filter and the signal's input power is derived, which demonstrates some unexpected behavior. GRA

N80-24522# Technology Service Corp., Santa Monica, Calif.
ADAPTIVE ARRAYS IN AN ADVANCED INTERFERENCE ENVIRONMENT Final Progress report
L. E. Brennan and I. S. Reed Oct. 1979 30 p refs
(Contract N00019-78-C-0497)
(AD-A081913; TSC-PD-A211-4) Avail: NTIS HC A03/MF A01 CSCL 09/3

When an adaptive array is implemented digitally, the sample covariance matrix algorithm provides a direct method of computing the adaptive weights and rapid convergence independent of the eigenvalues of the covariance matrix. Previous analyses of this algorithm have assumed that the weights are computed using one set of array element outputs and these weights are applied to later array outputs. This report considers the case where the adaptive weights are tested against the same set of data used in the weight computation. For many applications, the multiple channel sidelobe canceller is the preferred adaptive configuration. It can be shown that the sidelobe canceller is a special case of the more general adaptive arrray. In the next section it is shown that the general adaptive array problem can be transformed to an equivalent sidelobe canceller problem, a form which is more convenient for some analyses. It is also shown that the array performance is independent of this transformation, and that the effective weights, output S/N, etc., can be computed in any convenient coordinate system provided the transformation of coordinates is non-singular. GRA

N80-24523# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
PARAMETRIC INVESTIGATION OF RADOME ANALYSIS METHODS Annual Technical Report, 1 Oct. 1978 - 30 Sep. 1979

G. K. Huddleston, H. L. Bassett, and J. M. Newton Feb. 1980 41 p refs
(Grant AF-AFOSR-3489-77; AF Proj. 2301)
(AD-A082214; AFOSR-80-0218TR) Avail: NTIS HC A03/MF A01 CSCL 20/14

The status is described of a research program whose objective is to determine the accuracies of various methods of radome analysis as functions of antenna size and placement, radome size and shape, and wavelength. The analytical methods used and the experimental program to establish true data are described concisely. GRA

N80-24524# Stanford Univ., Calif. Stanford Electronics Labs.
COMPENDIUM OF THE ULF/ELF ELECTROMAGNETIC FIELDS GENERATED ABOVE A SEA OF FINITE DEPTH BY SUBMERGED HARMONIC DIPOLES Technical Report, 1 Jul. 1978 - 30 Jun. 1979
A. C. Fraser-Smith and D. M. Bubenik (SRI International, Menlo Park, Calif.) Jan. 1980 106 p
(Contract N00014-77-C-0292; NR Proj. 089-121)
(AD-A081952; SU-SEL-79-025; SU-TR-E715-1) Avail: NTIS HC A06/MF A01 CSCL 20/14

This report extends earlier computations of the amplitudes of the quasi-static electromagnetic fields produced on and above the surface of a sea of finite depth by a submerged vertically directed harmonic magnetic dipole (VMD) to other dipoles. Specifically, it now presents data for the fields produced by a submerged vertically directed harmonic electric dipole (VED) and by submerged horizontally directed magnetic and electric dipoles (HMD and HED, respectively). The primary purpose of these computations is to determine the conditions under which an electrically conducting sea floor can produce significant changes in the fields, as compared with the fields produced on and above an infinitely deep sea, for frequencies in the ULF/ELF bands (frequencies less than 3 kHz). As in the earlier work, this report finds that even a comparatively highly conducting sea floor (conductivity of approximately 0.4S/m) can produce substantial changes in the field amplitudes for some source-receiver configurations, and, in the case of the horizontal dipoles (as previously found for the VMD), alterations of two orders of magnitude or more can occur in the amplitudes on the sea surface for smaller values of sigma. GRA

N80-24525# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
FILTER RECEIVER DEVELOPMENT STUDY Final Report
J. E. Jackson, R. Anderson, and J. D. Kelley 15 May 1979 210 p refs
(Contract N00014-78-C-0717)
(AD-A082149) Avail: NTIS HC A10/MF A01 CSCL 17/2

An atomic resonance absorption and fluorescence (ARAF) filter is a viable filter concept providing background discrimination for blue-green laser communication to a submerged receiver. A detailed design has been accomplished which provides realistic performance parameters that are compared with other filter concepts. GRA

N80-24526# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
AN INVESTIGATION OF ATMOSPHERIC OPTICALLY SCATTERED NON-LINE-OF-SIGHT COMMUNICATION LINKS Final Report, Sep. 1978 - Sep. 1979
Warren S. Ross and Robert S. Kennedy 5 Jan. 1980 66 p refs
(Contract DAAG29-77-C-0048)
(AD-A082004; ARO-15365.2-A-el) Avail: NTIS HC A04/MF A01 CSCL 17/2

This report discusses the work performed in the second year of a two year program to investigate short-haul non-line-of-sight optical scatter communication links. The wavelength region considered for this study is the middle ultraviolet (uv) (2000 A - 3000 A). This region is attractive for communication purposes because the absence of solar background radiation makes wide-angle receivers practical. Futhermore, the short wavelengths result in significant scatter from molecular atmospheric constituents (Rayleigh scatter), so that the availability of a non-line-of-sight link is extended into clear weather. The goal of the investigation has been to obtain a fundamental understanding of scatter propagation in low visibility atmospheric environments. In particular, the work has focused on the determination of parameters needed for optical communication system design, such as angular spread and multipath time spread. GRA

N80-24527# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
A DIGITAL IF SIMULATOR FOR FM RANGING SYSTEMS
Marion C. Bartlett and Raymond C. Johnson Adelphi, Md. HDL Mar. 1980 25 p refs
(Contract DAAG39-78-C-0074; DA Proj. 1L6-62616-AH-77)
(AD-A082353; HDL-CR-80-074-1) Avail: NTIS HC A02/MF A01 CSCL 17/9

A digital intermediate frequency signal simulator (DIFSS) which is useful for testing many periodically modulated FM ranging systems is described. The DIFSS digitally computes the IF signal angle using angle tables stored in EPROM's and generates the cosine of the angle with a cosine PROM and D/A converter. Target delay time tau and doppler frequency can be varied as desired for static tests or dynamic target trajectories. The simulator is useful for testing real-time hardware or for testing ambiguous ranging system responses in a scaled-time mode. GRA

N80-24528# Electronics Research Lab., Adelaide (Australia).
TABLES OF RADAR CROSS SECTIONS OF HEMISPHERES ON PERFECTLY CONDUCTING GROUND PLANES
J. L. Whitrow Jul. 1979 142 p refs
(AD-A082050; ERL-0086-TR) Avail: NTIS HC A07/MF A01 CSCL 17/9

It is proposed that a hemisphere be used as the standard target when radar cross section measurements must be made of a target on or near a ground plane. These tables enable the radar cross section of any hemisphere whose radius is in the range 0.1 to 10.0 wavelengths to be determined for angles of observation up to 30 from the horizontal. Asymptotic expressions are presented for hemispheres outside the size range of the tables. A sphere is commonly used as the standard target in the calibration of radar cross section measurements because its backscatter cross section is invariant with aspect angle and is readily calculable to any desired order of accuracy. If however, the target undergoing measurement is located on or near a ground plane, complications arise if a sphere is to be used as the standard target because of the additional ray paths introduced between the radar and the sphere by reflections from the ground plane, and because the sphere can couple to itself, thus modifying its scattering characteristics, by other reflections from the ground plane. In general therefore the radar cross section of a sphere above a ground plane is not readily predictable, and will be strongly dependent upon the height of the sphere above the ground plane and the aspect angle. Thus the generally desirable properties of the sphere in isolation are no longer evident. GRA

N80-24529# Polytechnic Inst. of New York, Brooklyn. Microwave Research Inst.
APPLICATION OF SURFACE ACOUSTIC WAVE DEVICES TO COMMUNICATION RECEIVERS Final Technical Report, 1 Jul. 1977 - 30 Oct. 1979
Wen-Chung Wang, Harry Schachter, and Frank A. Cassara 14 Nov. 1979 51 p refs
(Grant AF-AFOSR-3353-77; AF Proj. 2305)
(AD-A082525; POLY-MRI-1403-79; AFOSR-80-0250TR) Avail: NTIS HC A04/MF A01 CSCL 17/2

This report relates to a study of acoustoelectric surface acoustic wave (SAW) devices for the detection of analog and digital communication signals. More specifically, a general SAW structure is shown to exhibit capabilities in demodulating amplitude, phase, and frequency modulated signals including those used in spread spectrum communication systems. The principle of operation for each device described is based upon acoustoelectric nonlinear interactions. The devices studied include the acoustoelectric phase-locked loop (PLL), SAW FM discriminator, differential phase shift-keyed (DPSK) demodulator, monolithic integrated SAW structures for the detection of spread spectrum communication signals, and an acoustoelectric voltage controlled oscillator (VCO). In addition, recognizing the importance of thin-film technology in fabricating monolithic integrated structures, we initiated a thin-film technology program. The capabilities and

limitations of each of these devices were examined theoretically and experimentally. Theoretical models which provide physical insight into each demodulator's performance and design rules were advanced. Comparisons were made with known electronic structures. GRA

N80-24530# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
MILLIMETER WAVE APPLICATIONS OF LARGE APERATURE SYSTEMS Final Technical Report, 30 Jun. 1978 - 31 Mar. 1979
Francois Ayer Griffiss AFB, N.Y. RADC Feb. 1980 163 p refs
(Contract F30602-78-C-0128; ARPA Order 3537; AF Proj. C537)
(AD-A082990; R-1301; RADC-TR-79-277) Avail: NTIS HC A08/MF A01 CSCL 17/9

This study proposes a structural design for the millimeter wave (MMW) antenna concept offered by Aerojet/NTL. It performs an assessment of the structural behavior of the satellite as it proceeds along its 500 km orbit. This effort concentrated on the definition and quantification of critical disturbances expected in the orbital environment. The design of a thermal blanket is arrived at through a number of thermal model analyses. The modeling of structural components and substructuring approaches are presented. The responses are evaluated for thermal loadings and dynamic disturbances. Based on the antenna deformational state, the performance is evaluated in term of point-spread functions (antenna loss of gain) and line-of-sight errors. A packaging and deployment technique is suggested for the surface panels, the back-up trusses and the feed tower to fit into the cargo bay of a single shuttle. Although the satellite is relatively heavy at 8800 kg, it is expected to perform satisfactorily in an almost completely passive manner. The evaluation of orbital dynamics shows the need for substantial propellent (2000 kg) to maintain the 500 km orbit. GRA

N80-24531# Naval Underwater Systems Center, New London, Conn. Special Projects Dept.
EFFECTS OF RANDOM SHADINGS, PHASING ERRORS, AND ELEMENT FAILURES ON THE BEAM PATTERNS OF LINEAR AND PLANAR ARRAYS
Albert H. Nuttall 14 Mar. 1980 57 p refs
(ZR0000101)
(AD-A082694; NUSC-TR-6191) Avail: NTIS HC A04/MF A01 CSCL 17/1

The moments of a sum of independent complex random variables are derived, up through fourth order, in complete generality, with no Gaussian assumptions. Applications of these results are made to linear and planar arrays, where the beamforming is subject to random shadings, phasing errors, and element failures. Expressions for the mean and variance of the random power transfer function of the array are presented. Programs and examples of their use are given for all of these results. GRA

N80-24532# Naval Ocean Systems Center, San Diego, Calif.
SIMPLIFIED VLF/LF MODE CONVERSION COMPUTER PROGRAMS; GRNDMC AND ARBNMC Interim Report, 1 Jan. - 31 Dec. 1979
D. G. Morfitt Jan. 1980 182 p refs Sponsored in part by DNA
(Contract MIPR-80-563)
(AD-A082695; NOSC/TR-514) Avail: NTIS HC A09/MF A01 CSCL 20/14

The computer programs GRNDMC and ARBNMC numerically determine vlf/lf mode conversion coefficients and mode sums for an earth-ionosphere waveguide which is inhomogeneous along the direction of propagation. GRNDMC generates values of the vertical electric field, Ez, at the ground as produced by a ground based vertical dipole source. ARBNMC calculates at an arbitrary height within the guide, all three electric field components (Ez, Ex and Ey) generated by an electric dipole of arbitrary orientation and height within the guide. The ARBNMC program treats air-to-air, ground-to-air or air-to-ground vlf/lf problems. It will also handle ground-to-ground propagation but is much less economical to run than GRNDMC. GRA

N80-24533# Illinois Univ. at Urbana-Champaign. Electromagnetics Lab.
STUDIES OF SOME BASIC PROBLEMS RELATED TO SATELLITE ANTENNA SYSTEMS Final Report, 1 Jul. 1977 - 30 Jun. 1979
S. W. Lee and R. Mittra Aug. 1979 11 p refs
(Grant AF-AFOSR-3375-77; AF Proj. 2305)
(AD-A081313; UIEM79-13; UILU-ENG-79-2557; AFOSR-80-0130TR) Avail: NTIS HC A02/MF A01 CSCL 09/5

This final report summarizes the technical effort in the past years on reflector and lens antennas. In particular, this report studied the computation of dual-reflector patterns by series expansion method and by GTD, synthesis of shaped dual reflectors, and mutual coupling effect in lenses. GRA

N80-24534# SRI International Corp., Menlo Park, Calif.
ANALYSIS OF UHF RADAR DATA - STRESS SERIES Final Report, May 1977 - Sep. 1978
Victor H. Gonzalez 1 Dec. 1978 103 p refs
(Contract DNA001-76-C-0341; DNA Proj. NWET-L25AAXHX635)
(AD-A082193; AD-E300689; DNA-4823F) Avail: NTIS HC A06/MF A01 CSCL 17/9

The data acquired by the UHF radar AN/FPS 85 while tracking the ion clouds resulting from the STRESS series of barium releases have been analyzed and the results presented. The calibration of the radar, and the motion and evolution of the ion clouds are described. The special problems of (1) correlation between optical features and radar measurements; (2) total ion inventory; and (3) early deposition of ions, have also been studied and the results are included in this report. GRA

N80-24535# Rome Air Development Center, Griffiss AFB, N.Y.
STUDY OF THE RADIATION PROPERTIES OF OVERLAPPED, SUBARRAYED SCANNING ANTENNAS
Ronald L. Fante Nov. 1979 42 p refs
(AF Proj. 2305)
(AD-A082401; RADC-TR-79-293) Avail: NTIS HC A03/MF A01 CSCL 17/9

Radar systems of the future will require wideband electronically steered antennas, with sidelobes below -40 dB. Because the cost of a fully time-delay steered array is excessive, the concept of overlapped subarray (with time delay controlled at the subarray feed input) is attractive. This concept seems to have originated with Rudge and Whithers, and Tang, and recently studied for limited scan by Borgiotti. In this paper we will study the sidelobe and bandwidth properties of this system for large scan angles. The basic configuration uses a circular lens fed by a hybrid matrix (with fixed time delays at the matrix output for subarray beam collimation). When an input port on the feed is excited, a distinct subarray distribution is produced on the output face of the lens. Therefore different time delays can be applied to each subarray simply by applying different time delays to each input port. The main array has phase shifters to produce a phase tilt that scans the subarray patterns. GRA

N80-24536# Ohio State Univ., Columbus. ElectroScience Lab.
COMMUNICATION APPLICATIONS OF ADAPTIVE ARRAYS Quarterly Report
R. T. Compton, Jr. Dec. 1979 8 p refs
(Contract N00019-79-C-0291)
(AD-A082350; ESL-711847-5) Avail: NTIS HC A02/MF A01 CSCL 17/2

This report describes progress on three areas of work. The first involves studies on weight jitter and dynamic range for the improved LMS loop. The second is a continuation of research on a reference signal generation technique for FSK signals. The third area involves the preparation of a monograph on adaptive arrays. GRA

N80-24537# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A UHF TEST SIMULATOR FOR AN ANTENNA NULLING SYSTEM
William C. Cummings, Thomas P. Robbio, William C. Provencher, John E. Drover, and Madhu Singhal 7 Jun. 1979 85 p refs
(Contract F19628-78-C-0002; AF Proj. 2029)

(AD-A082853; TN-1979-8; ESD-TR-79-157) Avail: NTIS HC A05/MF A01 CSCL 09/5

A UHF Test Simulator designed for use in testing adaptive antenna array nulling systems is described. The simulator consists of two major components: a Jammer Simulator and an Antenna Array Simulator. The Jammer Simulator can simulate up to eight independent jammers. The Array Simulator can simulate an array of eight elements in a four jammer environment. Operating details of both these simulators is discussed. GRA

N80-24538# Naval Research Lab., Washington, D. C.
A PATTERN-SYNTHESIS PROCEDURE FOR REGULAR PLANAR ARRAYS
J. Paul Shelton 14 Feb. 1980 19 p refs
(SF12141491)
(AD-A082798; AD-E000386; NRL-8368) Avail: NTIS HC A02/MF A01 CSCL 20/14

The synthesis of radiation pattern functions for symmetric hexagonal arrays is considered. The concept of number of degrees of freedom in the array illumination is introduced, and the pattern characteristics of the seven element array are developed. The relationship between multiplication of pattern functions and convolution of array illuminations is established. Synthesis techniques with zero and one degree of freedom are presented and demonstrated with examples. The technique with zero degrees of freedom generates hexagonal arrays which are analogous to linear arrays with binomial-coefficient illuminization. GRA

N80-24539# Ohio State Univ., Columbus. ElectroScience Lab.
AN APERTURE-MATCHED HORN DESIGN
W. D. Burnside and C. W. Chuang Jan. 1980 39 p refs
(Contract N00014-78-C-0049)
(AD-A083003; ESL-710816-5) Avail: NTIS HC A03/MF A01 CSCL 09/5

A novel horn design is presented in this report which provides significantly better performance in terms of the pattern, impedance and frequency characteristics than normally obtainable. The modification necessary to accomplish these improvements is achieved with a moderate increase in the size and weight; yet, the overall cost of design ad construction need not significantly increase. The basic concept utilizes an ordinary horn except that curved surface sections are attached to the outside of the aperture edges. Although all of the original studies associated with this new antennas were made using elliptic cylinder sections, they can be arbitrary smooth convex shapes which are attached to the horn such that the junction forms a smooth surface to the touch. GRA

N80-24540# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A NEW ALGORITHM FOR ADAPTIVE RADAR SIGNAL PROCESSING
Darrol F. DeLong 31 Dec. 1979 49 p refs
(Contract F19628-80-C-0002; AF Proj. 2217)
(AD-A082856; TN-1979-72; ESD-TR-79-312) Avail: NTIS HC A03/MF A01 CSCL 17/9

A new adaptive processing algorithm, called Weighted Covariance Estimation (WCE), for the detection of signals in interference of unknown character is presented. Its main advantage over present techniques, such as Sample MAtrix Inversion (SMI), is its tendency not to suppress desired signals present in the learning data. WCE and SMI are compared for a radar problem of practical interest, adaptive MTI from a moving platform, using both simulated and actual radar data. GRA

N80-24541# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AN EXTREMELY LIGHT-WEIGHT UHF DIPOLE ARRAY FOR SATELLITE APPLICATIONS
Charles A. Lindberg 11 Dec. 1979 30 p refs
(Contract F19628-80-C-002; AF Proj. 2029)
(AD-A082855; TN-1979-80; ESD-TR-79-282) Avail: NTIS HC A03/MF A01 CSCL 09/5

The development of an extremely light-weight, circularly-polarized crossed-dipole UHF antenna array is described. Performance characteristics of the array measured on a full-scale model including gain and VSWR curves are provided. Weighing only four pounds, the array provides a nominal 13 dB gain in the 290-400 MHz band. The unit is light weight and its durability makes it very attractive for use in satellite application. GRA

N80-24542# Fondazione Ugo Bordoni, Rome (Italy).
CALCULATION OF THE PARAMETERS OF THE RELATIONSHIP BETWEEN SPECIFIC ATTENUATION AND RAIN INTENSITY [CALCOLO DEI PARAMETRI DELLA RELAZIONE TRA ATTENUAZIONE SPECIFICA ED INTENSITA' DI PRECIPITAZIONE]
Francesco Fedi and Dario Maggiori Jul. 1978 17 p refs In ITALIAN
(FUB-35-1978) Avail: NTIS HC A02/MF A01

Starting from an ellipsoidal raindrop model, the parameters of the exponential relationship attenuation-rain intensity for vertical and horizontal polarizations are calculated for frequencies between 10 and 100 GHz. Author (ESA)

N80-24543# Fondazione Ugo Bordoni, Rome (Italy).
THE RELATIONSHIP OF ATTENUATION DIFFERENCES AND SPECIFIC PHASE DIFFERENCES TO RAINFALL INTENSITY [RELAZIONI TRA ATTENUAZIONI E FASI DIFFERENZIALI SPECIFICHE ED INTENSITA' DI PRECIPITAZIONE]
Francesco Fedi and Dario Maggiori Dec. 1978 19 p refs In ITALIAN
(FUB-36-1978) Avail: NTIS HC A02/MF A01

The parameters of the relationship between transmitting media anisotropy and rain intensity were studied to facilitate the calculation of cross polarization phenomena during microwave transmission using two orthogonally polarized carriers. Tables relating the specific attenuation and the specific phase difference to the rain intensity in both planes are presented. It is shown that the simple exponential approximation for the specific phase differences is not sufficient accurate in the region 30 to 40 GHz. Author (ESA)

N80-24544# Fondazione Ugo Bordoni, Rome (Italy).
STUDY OF A MEASURING SYSTEM FOR THE CHARACTERIZATION OF THE PHYSICAL MECHANISMS CAUSING DISCRIMINATION LOSS BETWEEN TWO ORTHOGONALLY POLARIZED TRANSMISSION CARRIERS [STUDIO DI UN SISTEMA DI MISURA PER LA CARATTERIZZAZIONE DEI MECCANISMI FISICI CAUSANTI DEGRADAZIONE DI DISCRIMINAZIONE TRA POLARIZZAZIONE ORTOGONALI]
Dario Maggiori, Piergiorgia Migliorini, and Aldo Paraboni (Politec. di Milan) Dec. 1978 50 p refs In ITALIAN
(FUB-37-1978) Avail: NTIS HC A03/MF A01

A study of a measuring system to characterize depolarization of millimetric waves at 30 GHz is presented. The theoretical accuracy limits required for measuring the interactions between non-spherical raindrops and coherent waves are discussed. The performance of measuring instruments is analyzed and the limits imposed by the existing research facilities are examined. It is concluded that such a measuring system is feasible in reference to the signal to noise ratio, while the effects due to the antenna polarization discrimination impose severe limitations.
Author (ESA)

N80-24545# Aalborg Univ. (Denmark). Inst. of Electronic Systems.
DIFFRACTION OF AN ELECTRIC POLARIZED WAVE BY A RIGHT-ANGLED DIELECTRIC WEDGE
Svend Bernsten Oct. 1978 37 p refs
(R-78-1) Avail: NTIS HC A03/MF A01

The problem of diffraction of an electromagnetic wave by a dielectric wedge is formulated as a singular integral equation. When the index of refraction is near unity the solution of this equation is constructed as a power series. A simple, general way to find an approximate solution is described. The error inherent in the method is shown to be very small; for a typical case considered the relative error of the edge source is calculated to be 10 to the minus 4 power. Author (ESA)

N80-24548# National Telecommunication Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
SWITCH ELEMENT CAPACITIES IN ACCESS AREA DIGITAL SWITCHING SYSTEMS

R. F. Linfield and M. Nesenbergs Sep. 1979 192 p refs Prepared for Army Communication Systems Agency, Ft. Monmouth, N.J.
(PB80-126139; NTIA-79/26) Avail: NTIS HC A09/MF A01 CSCL 17B

The capacity of a digital circuit switching system is defined in terms of its four major elements: the traffic offered by the interface element, the maximum traffic carried by the switch matrix, the maximum number of call attempts handled by the control processor, and the maximum number of calls handled by the signaling elements. These element capacities may be engineered for the expected traffic, the performance objectives, the processor capabilities, and the signaling techniques. In a properly engineered system, the interrelations between the capacity of all elements should be considered. Such interrelationships are discussed and representative switch configurations are characterized on the basis of the four major elements. GRA

N80-24547# National Telecommunication Information Administration, Annapolis, Md.
SPECTRUM RESOURCE ASSESSMENT IN THE 2.7-2.9 GHz BAND PHASE 2: RADAR SIGNAL PROCESSING
Robert L. Hinkle, Robert M. Pratt, and Jay S. Levy Aug. 1979 363 p refs
(PB80-129323; NTIA-79/25; Rept-2) Avail: NTIS HC A16/MF A01 CSCL 17G

The signal processing properties of the primary radars in the 2.7 to 2.9 GHz band, and the Automated Radar Terminal System (ARTS-IIIA) post processor planned for use by the Federal Aviation Administration on the Airport Surveillance Radars (ASRs) were investigated. The degree of congestion in the band in designated areas in the United States was assessed. It was concluded that some spectrum conservation techniques can be used by the radiodetermination services in the 2.7 to 2.9 GHz band to obtain more efficient utilization of the spectrum. Also, the current hardware in the later model primary radars and the ARTS-IIIA will suppress asynchronous interference with tradeoffs to the desired signal performance. GRA

N80-24694*# National Physical Lab., New Delhi (India). Radio Science Div.
IONOSPHERE-REFLECTED PROPAGATION
B. M. Reddy *In* NASA., Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 203-216 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 17B

N80-24695*# Air Force Geophysics Lab., Hanscom AFB, Mass.
TRANSIONOSPHERIC PROPAGATION PREDICTIONS
J. A. Klobuchar, Santimay Basu (Emmanuel Coll.), Sunanda Basu (Emmanuel Coll.), P. A. Bernhardt (Stanford Univ.), K. Davies (NOAA, Boulder, Colo.), D. E. Donatelli (Regis Coll.), E. J. Fremouw (Phys. Dyn., Inc., Bellevue, Wash.), J. M. Goodman (NRL, Washington, D.C.), G. K. Hartmann (Max-Planck Inst. fuer Aeronomie, Katlenburg-Lindau, West Germany), R. Leitinger (Graz Univ.) et al *In* NASA, Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 217-245 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 20N

N80-24721*# Norwegian Defence Research Establishment, Kjeller.
EFFECTS OF D REGION IONIZATION ON RADIO WAVE PROPAGATION
T. R. Larsen *In* NASA, Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 617-654 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 20N

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N80-24548* Duke Univ., Durham, N. C. Dept. of Electrical Engineering.
DYNAMICS EXPLORER POWER SUBSYSTEM STUDY, PHASE B
R. C. Wong, H. A. Owen, Jr., and T. G. Wilson 16 Oct. 1979 58 p refs
(Contract NAS5-25351)
(NASA-CR-159983) Avail: Issuing Activity CSCL 09C

Modifications to the Atmospheric Explorer power system required to meet the Dynamics Explorer mission requirements are described. These include raising the switching of the 24.5 V switching regulator to 21 kHz and inserting a solar array filter between the solar array and the shunt bus. Small signal analysis is used to characterize the 24.5 V switching regualtor in order to investigate the possibility of instability and/or undesired system oscillation due to such modifications. The rest of the system is modeled as an equivalent source impedance as seen by the regulator. The stability of the 24.5 V switching regulator in the presence of the equivalent source impedance as well as the stability of the system bus voltage are analyzed extensively. J.M.S.

N80-24549*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ELECTRICALLY CONDUCTIVE PALLADIUM CONTAINING POLYIMIDE FILMS Patent Application
Larry T. Taylor (Virginia Polytech. Inst. and State Univ.), Anne K. StClair (Virginia Polytech. Inst. and State Univ.), Vicki C. Carver (Virginia Polytech. Inst. and State Univ.), and Thomas A. Furtsch, inventors (to NASA) (Virginia Polytech. Inst. and State Univ.) Filed 28 Mar. 1980 16 p Sponsored by NASA
(NASA-Case-LAR-12705-1; US-Patent-Appl-SN-135058) Avail: NTIS HC A02/MF A01 CSCL 09A

A method is described for preparing lightweight, high temperature resistant, electrically conductive, palladium containing, polyimide films for use on aerodynamic and space applications. A palladium (2) ion-containing polymamic acid solution is prepared by reacting an aromatic dianhydride with an equimolar quantity of a palladium 2 ion-containing salt or complex. The reactant product is cast as a thin film onto a surface and cured at approximately 300 C to produce a flexible electrically conductive cyclic palladium containing polyimide. The source of palladium ions is selected from the gruop of palladium 2 compounds consisting of LiPdC14, Pd[S(CH3)2]2Cl2, Na2PdC14, and PdC14. NASA

N80-24550*# Three E Vehicles, San Diego, Calif.
THE PERFORMANCE AND EFFICIENCY OF FOUR MOTOR/CONTROLLER/BATTERY SYSTEMS FOR THE SIMPLER ELECTRIC VEHICLES Final Report
Paul R. Shipps May 1980 88 p refs
(Contracts DEN3-130; EC-77-A-31-1044)
(NASA-CR-159776; DOE/NASA/0130-80/1) Avail: NTIS HC A05/MF A01 CSCL 09C

A test and analysis program performed on four complete propulsion systems for an urban electric vehicle (EV) is described and results given. A dc series motor and a permanent magnet (PM) motor were tested, each powered by an EV battery pack and controlled by (1) a series/parallel voltage-switching (V-switch) system; and (2) a system using a pulse width modulation, 400 Hz transistorized chopper. Dynamometer tests were first performed, followed by eV performance predictions and data correlating road tests. During dynamometer tests using chopper control; current, voltage, and power were measured on both the battery and motor sides of the chopper, using three types of instrumentation. Conventional dc instruments provided adequate accuracy for eV power and energy measurements, when used on the battery side of the controller. When using the chopper

controller, the addition of a small choke inductor improved system efficiency in the lower duty cycle range (some 8% increase at 50% duty cycle) with both types of motors. Overall system efficiency rankings during road tests were: (1) series motor with V-switch; (2) PM motor with V-switch; (3) series motor with chopper; and (4) PM motor with chopper. Chopper control of the eV was smoother and required less driver skill than V-switch control. M.G.

N80-24551*# Sperry Flight Systems, Phoenix, Ariz.
MAGNETIC SUSPENSION SYSTEM FOR AN ANNULAR MOMENTUM CONTROL DEVICE (AMCD)
Dec. 1979 114 p
(Contract NAS1-14502)
(NASA-CR-159255) Avail: NTIS HC A06/MF A01 CSCL 09C

A technique to control a rim suspended in a magnetic field was developed. A complete system was developed, incorporating a support structure, magnetic actuators, a rim drive mechanism, an emergency fail-safe system, servo control system, and control electronics. Open loop and closed loop response of the system at zero speed and at 500 revolutions per minute (r/min) of the rim was obtained and analyzed. The rim was then dynamically balanced and a rim speed of 725 r/min was achieved. An analog simulation of the hardware was developed and tested with the actual control electronics connected to the analog computer. The system under development is stable at rim speeds below 700 r/min. Test results indicate that the rim under test is not rigid. The rim has a warp and a number of binding modes which prevented achievement of higher speeds. Further development efforts are required to achieve higher rim speeds. J.M.S.

N80-24552*# Raytheon Co., Waltham, Mass.
SURFACE ACOUSTIC WAVE STABILIZED OSCILLATORS Final Report, 15 Aug. 1978 - 14 Aug. 1979
T. E. Parker, D. L. Lee, and I. Leja Sep. 1979 79 p
(Contract NAS5-25117)
(NASA-CR-159980; S-2604) Avail: NTIS HC A05/MF A01 CSCL 09A

Four areas of surface acoustic wave (SAW) controlled oscillators were investigated and a number of 401.2 MHz oscillators were constructed that showed improved performance. Aging studies on SAW devices packaged in HC36/U cold weld enclosures produced frequency drifts as low as 0.4 ppm in 35 weeks and drift rates well under 0.5 ppm/year. Temperature compensation circuits have substantially improved oscillator temperature stability, with a deviation of + or - 4 ppm observed over the range -45 C to + 40 C. High efficiency amplifiers were constructed for SAW oscillators and a dc to RF efficiency of 44 percent was obtained for an RF output of 25 mW. Shock and vibration tests were made on four oscillators and all survived 500 G shock pulses unchanged. Only when white noise vibration (20 Hz to 2000 Hz) levels of 20 G's rms were applied did some of the devices fail. J.M.S.

N80-24553# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
MANUFACTURING METHODS AND TECHNOLOGY FOR DIGITAL FAULT ISOLATION FOR PRINTED CIRCUIT BOARDS Interim Report, Sep. 1978 - Aug. 1979
25 Aug. 1979 734 p refs
(Contract DAAK40-78-C-0290; Proj. R783242)
(AD-A080839; HAC-FR79-12-669A) Avail: NTIS HC A99/MF A01 CSCL 09/5

This report describes the manufacturing technology that will enable detection, identification, and location of digital faults in advanced digital missile electronic systems. Emphasis is placed on the fault diagnosis of large printed circuit boards containing complex digital hybrid microelectronic circuits to be used in the 1980's. The identified technology provides the capability to isolate digital faults to the minimum size component level, using state-of-the-art automatic test equipment. The effort included an industry survey for digital printed circuit board test requirements and available test system capabilities, the development of digital fault isolation methodology, and the identification of the corresponding optimum available automatic test hardware. The subsequent contract option phase of this project involves the purchase, setup, and demonstration of the selected fault isolation hardware/software system, using the developed techniques.GRA

N80-24554# Lincoln Lab., Mass. Inst. of Tech., Lexington.
TRANSCONDUCTANCE MULTIPLIERS FOR WEIGHT CIRCUITS
J. Nelson Wright 1 Jun. 1979 47 p refs
(Contract F19628-78-C-0002; AF Proj. 2029)
(AD-A081796; TN-1979-11; ESD-TR-79-99) Avail: NTIS HC A03/MF A01 CSCL 09/3

The design, construction, and measurement of weight circuits utilizing four quadrant transconductance multiplication is described. The weights operate over a 10 MHz band centered at 121.4 MHz. GRA

N80-24555# Texas Instruments, Inc., Dallas.
IC FABRICATION USING ELECTRON-BEAM TECHNOLOGY Final Report, 1 Jul. 1978 - 30 Jun. 1979
Gilbert L. Varnell, John Bartelt, and Jack Reynolds Feb. 1980 70 p refs
(Contract DAAB07-78-C-8105; DA Proj. 1L1-62705-AH-94)
(AD-A082237; TI-03-79-57; DELET-TR-78-8105-F) Avail: NTIS HC A04/MF A01 CSCL 09/3

The development of a manufacturing capability for standard bipolar circuits of conventional design using existing e-beam direct writing equipment is described. In particular, a pilot-line demonstration of significant yields of conventional 4 to 5 micrometer design rule integrated circuits which were fully tested to military specifications for performance, quality and reliability is discussed. The vehicle used for this demonstration was a standard TTL 256 bit bipolar RAM using a single level metal, junction isolated, Schottky clamped bipolar process. Emphasis was placed on utilizing a new class of high-speed electron resist in combination with selective plasma etching techniques in order to establish economical next generation very large scale integration processes. A vector scan, laser controlled e-beam direct writing system, developed with fully automatic slice alignment, was used for patterning of these devices. To determine that e-beam direct writing yields devices with no degradation in performance or reliability, optically patterned split lot controls were fabricated in parallel and used for comparative testing. M.G.

N80-24556# Maine Univ., Orono. Dept. of Electrical Engineering.
MICROWAVE SURFACE ACOUSTIC WAVE MATERIALS Final Scientific Report, 15 Feb. 1975 - 1 Jun. 1979
John F. Vetelino Feb. 1980 102 p refs
(Grant AF-AFOSR-2816-75; AF Proj. 2306)
(AD-A082079; AFOSR-80-0135TR) Avail: NTIS HC A06/MF A01 CSCL 09/3

The acoustic wave properties of several piezoelectric crystals and a layered structure have been theoretically and experimentally investigated for possible application in microwave acoustic devices. A search was made for crystals and layered structures having one or more of the following properties: (1) temperature compensation; (2) high piezoelectric coupling; (3) low power flow angle; (4) low loss; and (5) low or high acoustic wave velocities. The acoustic waves studied were the bulk acoustic waves (BAW), the surface acoustic waves (SAW), the pseudo SAW (PSAW), the plate modes and the surface skimming bulk waves (SSBW). The wave properties studied were the velocity, piezoelectric coupling, the temperature coefficient of delay, diffraction and attenuation. The layered geometries examined studied included fused silica on LiNbO3 and gold, aluminum and copper layers on quartz. The overlay structures were found to be more temperature stable than the single crystals. A theory describing the spectrum of acoustic waves emanating from an interdigital transducer was developed. Several promising cuts for SSBW in quartz were identified and studied both theoretically and experimentally. Finally, various prototype SSBW devices were fabricated and tested. GRA

N80-24557# University Coll., Cork (Ireland). Microelectronics Research Center.
SUBMILLIMETER SCHOTTKY DIODES WITH ELECTRON BEAM LITHOGRAPHY Annual Technical Report, Jul. 1978 - Nov. 1979
John B. Langley, II and G. T. Wrixon Dec. 1979 58 p refs

(Grant DA-ERO-78-G-078; DA Proj. 1T1-61102-BH-57)
(AD-A082358) Avail: NTIS HC A04/MF A01 CSCL 09/5

A microprocessor based electron beam lithography system has been developed for production of Schottky barrier diodes with submicron geometric features. The electron beam lithography system is described along with details of the fabrication procedure. Complete logic diagrams and listings of the microprocessor operating software are included. GRA

N80-24558# Northrop Corp., Des Plaines, Ill. Defense Systems Div.

I/J BAND LOW COST CROSSED-FIELD AMPLIFIER Interim Technical Report, 31 Mar. - 30 Sep. 1979

Robert R. Moats Feb. 1980 40 p refs

(Contract DAAB07-78-C-2981; DA Proj. 1L1-62705-AH-94)
(AD-A081861; Rept-094-009246; ITR-2; DELET-TR-78-2981-2) Avail: NTIS HC A03/MF 01 CSCL 09/5

This program is directed toward development of an I/J band, linear format, injected-beam crossed-field amplifier (IBCFA) for electronic warfare. The IBCFA should be capable of power output of 1000 W peak, 200 W average, between 8.5 and 17 GHz with 20 dB gain. A laser-cut shaped-substrate meander line is used. The performance objectives for E/F band CFA's include 3 kW peak pulse power output and 1 kW average power output, 20 dB gain, 2-4 GHz, for electronic warfare; and 2 kW peak pulse power output at 10-15% duty, 25 dB gain, 3.0 to 3.6 GHz, for phased-array radar. One E/F band tube has been built. Preliminary tests at 10% duty directed toward electronic warfare applications showed 3 kW peak power at midband, 1.5 kW at 2 GHz, and 2.4 kW at 4 GHz. Increased drive power leads to greater power output at the low end of the band, indicating the need for greater circuit length. This tube will be tested further for its characteristics in the phased array mode and for full rated duty in the electronic warfare mode. Another E/F band tube is under construction, this one with increased circuit length. GRA

N80-24559# Air Force Systems Command, Wright-Patterson AFB, Ohio.

ANALYSIS OF TRAVELING WAVES IN UNDERGROUND CABLES

Eduard Hoefler Feb. 1980 15 p refs Transl. into ENGLISH from Elektroprivreda (Yugoslavia), v. 30, no. 7-8, 1977 p 215-219
(AD-A082326; FTD-ID(RS)T-1864-79) Avail: NTIS HC A02/MF A01 CSCL 20/14

The form of overvoltage in underground cables for a wave with a vertical front and a falling crest is analyzed. The derived expression enables an estimate of the voltage in the cable as a function of time for any length of cable and duration of the overvoltage wave. The shorter the cable the more accurate the calculation. Figures show overvoltages in cables between two power lines and between a power line and a transformer (assuming certain wave resistances). J.M.S.

N80-24560# Kaman Sciences Corp., Colorado Springs, Colo.

NOISE CANCELLATION TRANSDUCER DEVELOPMENT PROGRAM Final Report, Jan. 1977 - May 1979

Vernon D. Peckham and Robert T. Winnicki 31 May 1979 75 p refs
(Contract DNA001-77-C-0110)
(AD-A082801; AD-E300700; K-79-38; DNA-195048) Avail: NTIS HC A04/MF A01 CSCL 17/1

This report describes the development and ground testing of an acoustic sensor to detect boundary layer transition on models in high acoustic noise wind tunnel facilities. The noise cancellation transducer utilizes the Boundary Layer Acoustic Monitor (BLAM) detection concept to monitor the flow and employs a subtractive technique to cancel out coherent noise components to improve the signal to noise ratio. GRA

N80-24561# Yeshiva Univ., New York, N. Y.

SYSTEMATIC STUDY OF PYROELECTRICITY. APPLICATIONS OF PYROELECTRIC MATERIALS Final Technical Report, 1 Oct. 1975 - 31 Mar. 1977

M. I. Bell and Y. H. Tsuo Ft. Monmouth, N.J. Army Electronics Research and Development Command Jul. 1979 79 p refs
(Contracts DAAB07-76-C-1342; DAAB07-74-C-0470)
(AD-A082435; DELET-TR-76-1342-F) Avail: NTIS HC A05/MF A01 CSCL 20/3

Full accounts are given of theoretical and experimental studies of ferroelectric phase transitions begun under a previous contract and completed under the present one. The findings of these studies are applied to the analysis of several applications of pyroelectric materials and to the evaluation of the suitability of various ferroelectrics for these uses. A major result is that improper ferroelectrics, in which the polarization is not the order parameter, are predicted to have performance superior to that of proper ferroelectrics in both infrared imaging and thermal-to-electrical energy conversion applications. Experimental evidence is presented supporting this conclusion in the case of the pyroelectric vidicon. GRA

N80-24562# Syracuse Univ., N. Y.

NONLINEAR SYSTEM ANALYSIS IN BIPOLAR INTEGRATED CIRCUITS Progress Report, Sep. 1977 - Oct. 1979

Te-Fang Fang and James J. Whalen Griffiss AFB, N.Y. RADC Jan. 1980 268 p refs Prepared in cooperation with State Univ. of New York at Buffalo
(Contracts F30602-79-C-0011; F30602-75-C-0122)
(AD-A082527; RADC-TR-79-324) Avail: NTIS HC A12/MF A01 CSCL 09/5

Since analog bipolar integrated circuits (IC's) have become important components in modern communication systems, the study of the Radio Frequency Interference (RFI) effects in bipolar IC amplifiers is an important subject for electromagnetic compatibility (EMC) engineering. The investigation has focused on using the nonlinear circuit analysis program (NCAP) to predict RF demodulation effects in broadband bipolar IC amplifiers. The audio frequency (AF) voltage at the IC amplifier output terminal caused by an amplitude modulated (AM) RF signal at the IC amplifier input terminal was calculated and compared to measured values. Two broadband IC amplifiers were investigated: (1) a cascode circuit using a CA3026 dual differential pair; (2) a unity gain voltage follower circuit using a micro A741 operational amplifier (op amp). Before using NCAP for RFI analysis, the model parameters for each bipolar junction transistor (BJT) in the integrated circuit were determined. Probe measurement techniques, manufacturer's data, and other researcher's data were used to obtain the required NCAP BJT model parameter values. An important contribution included in this effort is a complete set of NCAP BJT model parameters for most of the transistor types used in linear IC's. GRA

N80-24563# Raytheon Co., Bedford, Mass. Missile Systems Div.

RELIABILITY EVALUATION OF LOW POWER SCHOTTKY CLAMPED MICROCIRCUITS Final Technical Report, Sep. 1977 - Oct. 1979

K. B. Lasch, D. Bartels, J. J. Spinale, and P. H. Ackroyd Griffiss AFB, N.Y. RADC Feb. 1980 364 p refs
(Contract F30602-77-C-0186; AF Proj. 2338)
(AD-A082926; RADC-TR-80-5) Avail: NTIS HC A16/MF A01 CSCL 09/5

An evaluation study has been completed on T2L Schottky integrated circuits of medium to large scale integration. The study consisted of electrical and physical characterization, step stress and accelerated long term testing, failure analysis and failure rate determination. The objective of this study was to verify the suitability of these devices for incorporation in advanced digital military systems. Five device types were selected and each was procured from two manufacturers. Device selection was based upon the availability of the MIL-M-38510 slash sheet at the time of selection, and manufacturer selection was based upon his offering the greatest number of the devices selected. In all, in excess of 1000 devices from four different manufacturers were included in the study. Electrical characterization was accomplished on computer-based test systems augmented by bench testing of transfer characteristics and thermal resistance. GRA

N80-24564# Oak Ridge National Lab., Tenn. Atomic Molecular and High Voltage Physics Group.

HIGH VOLTAGE RESEARCH (BREAKDOWN STRENGTHS

OF GASEOUS AND LIQUID INSULATORS) AND ENVIRONMENTAL EFFECTS OF DIELECTRIC GASES Semiannual Report, 1 Apr. - 30 Sep. 1979
L. G. Christophorou, D. R. James, R. Y. Pai, R. A. Mathis, I. Sauers, L. Frees, M. O. Pace, D. W. Bouldin, and C. C. Chan Jan. 1980 128 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7173) Avail: NTIS HC A07/MF A01

Electron attachment rates were measured and unfolded to give attachment cross section junctions for CCl3F, CCl2F, and CClF3 each in N2, and for CCl3F in Ar. Electron attachment rates were measured also for n-C6F14 in both Ar and N2. The effects of molecular structure on energy cross section, and lifetime of negative ion states of organic molecules were considered. The potential role of electron detachment in breakdown and the role of dipolar scattering of electrons in inhibiting breakdown was investigated. The nature of synergisms among constituents of a gas dielectric mixture is discussed. Examples are cited from recent breakdown measurements. The initial fragmentation of 1,1,2-C2Cl3F2 under electron impact was studied. Final decomposition products of sparked SF6/2-C4F6 mixtures were identified and quantified. The breakdown products of SF6 were studied. In the study of liquid dielectrics n-hexane and perfluoro-n-hexane were tested. DOE

N80-24565# Brookhaven National Lab., Upton, N. Y.
ANALYSIS OF CRITICAL-BEND STRAIN RELATIONSHIPS IN COMPOSITE Nb3Sn SUPERCONDUCTING WIRES
Thomas Luhman and D. O. Welch 1979 5 p refs Presented at the 8th Symp. on Eng. Probl. of Fusion Res., San Francisco, 13 Nov. 1979
(Contract EY-76-C-02-0016)
(BNL-26989; CONF-791102-86) Avail: NTIS HC A02/MF A01

Nb3Sn conductors must meet several mechanical strain criteria including tolerance to bending strains encountered during fusion magnet construction. The dependence of critical current on bending strains in monofilamentary Nb3Sn wires is calculated and compared with experimental data. The calculation takes into account a shift in the composite's neutral axis which occurs during bending. The analysis correctly predicts the observed dependence of the critical current on bending strains. DOE

N80-24566# Sandia Labs., Albuquerque, N. Mex.
RESEARCH AND APPLICATION OF PULSED-POWER TECHNOLOGY
Gerald Yonas 12 Jan. 1980 19 p
(Contract EY-76-C094-0789)
(SAND-80-0177C) Avail: NTIS HC A02/MF A01

Pulsed power technology relating to that branch which was simulated by military applications in the 1960's is addressed. A history of the development and characteristics of some devices producing intense electron and ion beams which resulted in Sandia's particle beam fusion program is presented. These include Hermes II, Aurora, Hydra, and Proto II. Research on inertial confinement fusion ignition (ICF) is described, and the most critical issue in ICF today still is the demonstration of ignition and efficient burnup of a small amount of thermonuclear fuel. Progress on particle beam fusion accelerators is reported. DOE

N80-24567# Royal Aircraft Establishment, Farnborough (England).
COMPUTER PROGRAMS FOR THE DESIGN OF ACTIVE RC FILTERS
L. J. Richards London HMSO Mar. 1979 92 p refs
(RAE-TR-79038; RAE-RAD-NAV-76; BR70157) Avail: NTIS HC A05/MF A01

Three ALGOL 68-R programs which can be used as aids to the design of active RC filters are described. Two programs calculated the performance of standard all-pole filter types: the first program calculating the attenuation and the second the group delay. The third program calculates component values needed to implement the filter as a cascade connection of first or second order sections. Sensitivity and gain performance can also be calculated. Algorithms are described which ensure that where possible component values lie within specified bounds and take standard values. Specifications of the programs are given, together with examples of their use. Author (ESA)

N80-24568# Laboratorio di Ricerca e Technologia per lo Studio del Plasma nello Spazio, Frascati (Italy).
A PARAMETRIC TRANSDUCER FOR THE DETECTION OF SMALL DISPLACEMENTS [TRASDUTTORE PARAMETRICO PER LA RIVELAZIONE DI PICCOLI SPOSTAMENTI]
F. Bordoni Mar. 1979 17 p refs In ITALIAN
(LPS-79-3) Avail: NTIS HC A02/MF A01

A parametric transducer used for the detection of vibrations in a gravitational antenna is described. Several noise sources were examined in detail, comparing the noise sensitivity of the described transducer with previously described transducers. Performance comparable to that of a microwave detector is attainable operating at much lower frequencies without using very high Q resonant circuits. Author (ESA)

N80-24569# Royal Aircraft Establishment, Farnborough (England).
A THICK FILM MICROSTRIP BUTLER MATRIX FOR THE FREQUENCY RANGE 1.5 TO 1.7 GHz
A. G. Tabb London HMSO Sep. 1979 96 p refs
(RAE-TR-79118; RAE-Space-568; BR72772) Avail: NTIS HC A05/MF A01

The design, construction, and electrical measurement of a 4 by 4 Butler Matrix for the 1.5 to 1.7 GHz frequency range are described. The Matrix was constructed in thick film technology on an alumina substrate. A computer aided design package was used for the circuit synthesis. As an application example, the use of this Matrix as a submatrix for a 16 by 16 Matrix which could be part of the feed system of a satellite borne steerable beam phased array of radiators allowing complete Earth coverage is discussed. Author (ESA)

N80-24570# National Bureau of Standards, Washington, D.C. Electron Devices Div.
ZINC OXIDE VARISTORS FOR LIGHTNING ARRESTER SERVICE Final Report, Oct. 1978 - Sep. 1979
Robert I. Scace Jan. 1980 25 p refs Sponsored in part by DOE
(PB80-144645; NBSIR-79-1939) Avail: NTIS HC A02/MF A01 CSCL 09A

The application of zinc oxide varistors to high power surge arresters for electrical transmission lines is considered, with particular attention to the special measurement problems posed by the application and by the unique properties of these varistors. The development of ZnO varistors and the present theory of ZnO varistor action are discussed. The need for further elaboration of the theory is considered. GRA

N80-24887*# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
MAGNETIC STORM EFFECTS IN ELECTRIC POWER SYSTEMS AND PREDICTION NEEDS
Vernon D. Albertson and John G. Kappenman (Minnesota Power and Light Co.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 137-148 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 09C

N80-24888*# British Columbia Univ., Vancouver. Dept of Geophysics and Astronomy.
THE PROBLEM OF SOLAR INDUCED CURRENTS
D. H. Boteler *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 149-161 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 09C

N80-24889*# Manitoba Univ., Winnipeg. Dept. of Electrical Engineering.
PREDICTION OF SOLAR INDUCED CURRENTS AND EFFECTS ON POWER TRANSMISSION SYSTEMS IN CENTRAL CANADA
W. R. Goddard and W.-M. Boerner (Illinois Univ. at Chicago Circle) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 162-171 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 09C

N80-24890*# British Columbia Univ., Vancouver. Dept. of Geophysics and Astronomy.
HARMONICS OF 60 Hz IN POWER SYSTEMS CAUSED BY GEOMAGNETIC DISTURBANCES
K. Hayoshi, T. Oguti, T. Watanabe, K. Tsuruda, S. Kokubun, and R. E. Horita (Victoria Univ., British Columbia) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 172-181 refs Prepared in cooperation with Tokyo Univ., Japan (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 09C

N80-24891*# Geological Survey, Denver, Colo.
INDUCED ELECTRIC CURRENTS IN THE ALASKA OIL PIPELINE MEASURED BY GRADIENT, FLUXGATE, AND SQUID MAGNETOMETERS
Wallace H. Campbell and James E. Zimmerman (NBS, Boulder, Colo.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 182-192 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N80-24571 State Univ. of New York at Stony Brook.
INTERFEROMETRIC STUDIES OF NATURAL CONVECTIVE HEAT TRANSFER IN VARIOUS AIR SPACE GEOMETRIES Ph.D. Thesis
Yih-Jung Yeh 1980 201 p
Avail: Univ. Microfilms Order No. 8011337

Mach-Zehnder interferometric methods were employed to identify, modify, and improve the thermal performance of various air spaces. Horizontal balsa wood dividers were employed as separators in a vertical rectangular air space where an imposed temperature gradient is maintained across the short dimension. The balsa wood separators were employed to create a multiplicity of subspaces of the original rectangular space. Experimental results show that free convection was suppressed by the introduction of the balsa wood dividers in the studied air spaces. It is found that the overall Nusselt number is decreased where the free convective heat transfer dominates. The Nusselt number is increased where the conductive heat transfer dominates. The effects of air leaks on the boundaries, which allowed air mass exchange among the divided air spaces, were investigated. Results show that contiguous air spaces which are coupled by small air leaks provide heat transfer rates which are approximately the same as for the uncoupled air space systems. Cellularization of large air spaces is shown to be a useful tool for suppression of convective heat transfer. Dissert. Abstr.

N80-24572 Texas Univ. at Austin.
DETERMINATION OF FRICTION FACTORS AND HEAT TRANSFER COEFFICIENTS FOR FLOW PAST ARTIFICIALLY ROUGHENED SURFACES Ph.D. Thesis
Stephen Andrew Hodge 1979 224 p
Avail: Univ. Microfilms Order No. 8009873

A critical review of the underlying assumptions, theoretical foundations, and supporting experimental evidence for the analytical procedures in current use for the evaluation of roughness effects of heat transfer surfaces of gas cooled reactors are discussed. A method is demonstrated for determination of the slope and intercept of the universal logarithmic dimensionless velocity distribution law for past roughened surfaces without the need for experimental measurement of the velocity profile. The slope is shown to vary with the nature of the roughened surface and to deviate considerably from the slope for turbulent flow past smooth walls in some cases. It is further shown that the intercept, which is a boundary condition equivalent to the roughness parameter for friction, is independent of the width of the velocity profile. The dependence noted by previous investigators was due to their assumption that the slope of the dimensionless velocity profile for flow past rough surfaces has a value equal to that of the slope of this profile in flow past smooth surfaces. A similar method is developed for determination of the slope and intercept of the dimensionless temperature distribution law, but additional experimental investigation is required before the efficacy of this application can be conclusively established. Dissert. Abstr.

N80-24573* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HEAT EXCHANGER AND METHOD OF MAKING Patent
Anthony Fortini and John M. Kazaroff, inventors (to NASA) Issued 29 Apr. 1980 6 p Filed 30 Nov. 1977 Supersedes N79-21313 (17 - 02, p 0164) Div. of US Patent Appl. SN-559848, filed 19 Mar. 1975; US Patent No-4,108,241
(NASA-Case-LEW-12441-2; US-Patent-4,199,937; US-Patent-Appl-SN-856462; US-Patent-Class-60-267; US-Patent-Class-239-127.1; US-Patent-Appl-SN-559848) Avail: US Patent and Trademak Office CSCL 20D

A heat exchange of increased effectiveness is disclosed. A porous metal matrix is disposed in a metal chamber or between walls through which a heat-transfer fluid is directed. The porous metal matrix has internal bonds and is bonded to the chamber in order to remove all thermal contact resistance within the composite structure. Utilization of the invention in a rocket chamber is disclosed as a specific use. Also disclosed is a method of constructing the heat exchanger.
Official Gazette of the U.S. Patent and Trademark Office

N80-24574*# Mississippi State Univ., State College. Dept. of Aerospace Engineering.
NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR HIGH REYNOLDS NUMBER INCOMPRESSIBLE TURBULENT FLOW M.S. Thesis
David S. Thompson May 1980 68 p refs
(Grant NGR-25-001-055)
(NASA-CR-163154) Avail: NTIS HC A04/MF A01 CSCL 20D

The full Navier-Stokes equations for incompressible turbulent flow must be solved to accurately represent all flow phenomena which occur in a high Reynolds number incompressible flow. A two layer algebraic eddy viscosity turbulence model is used to represent the Reynolds stress in the primitive variable formulation. The development of the boundary-fitted coordinate systems makes the numerical solution of these equations feasible for arbitrarily shaped bodies. The nondimensional time averaged Navier-Stokes equations, including the turbulence mode, are represented by finite difference approximations in the transformed plane. The resulting coupled system of nonlinear algebraic equations is solved using a point successive over relaxation iteration. The test case considered was a NACA 64A010 airfoil section at an angle of attack of two degrees and a Reynolds number of 2,000,000. A.R.H.

N80-24575*# Tennessee State Univ., Nashville. Dept. of Mechanical Engineering.
AN INVESTIGATION OF THE MOTION OF SMALL PARTICLES AS RELATED TO THE FORMULATION OF ZERO GRAVITY EXPERIMENTS Final Report
V. S. Sastry May 1980 17 p refs
(Grant NsG-8032)
(NASA-CR-163146) Avail: NTIS HC A02/MF A01 CSCL 20D

The nature of Brownian motion and historical theoretical investigations of the phenomemon are reviewed. The feasibility of using a laser anemometer to perform small particle experiments in an orbiting space laboratory was investigated using latex particles suspended in water in a plastic container. The optical equipment and the particle Doppler analysis processor are described. The values of the standard deviation obtained for the latex particle motion experiment were significantly large compared to corresponding velocity, therefore, their accuracy was suspect and no attempt was made to draw meaningful conclusions from the results. A.R.H.

N80-24576*# Old Dominion Univ. Research Foundation, Norfolk, Va.

TAP 2: A FINITE ELEMENT PROGRAM FOR THERMAL ANALYSIS OF CONVECTIVELY COOLED STRUCTURES
Contractor Report, Oct. 1976 - Jan. 1980
Earl A. Thornton May 1980 88 p refs
(NASA-CR-159038) Avail: NTIS HC A05/MF A01 CSCL 20D

A finite element computer program (TAP 2) for steady-state and transient thermal analyses of convectively cooled structures is presented. The program has a finite element library of six elements: two conduction/convection elements to model heat transfer in a solid, two convection elements to model heat transfer in a fluid, and two integrated conduction/convection elements to represent combined heat transfer in tubular and plate/fin fluid passages. Nonlinear thermal analysis due to temperature-dependent thermal parameters is performed using the Newton-Raphson iteration method. Transient analyses are performed using an implicit Crank-Nicolson time integration scheme with consistent or lumped capacitance matrices as an option. Program output includes nodal temperatures and element heat fluxes. Pressure drops in fluid passages may be computed as an option. User instructions and sample problems are presented in appendixes. Author

N80-24577*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXTENSION OF SIMILARITY TEST PROCEDURES TO COOLED ENGINE COMPONENTS WITH INSULATING CERAMIC COATINGS
Herbert J. Gladden May 1980 16 p refs
(NASA-TP-1615; E-337) Avail: NTIS HC A02/MF A01 CSCL 20D

Material thermal conductivity was analyzed for its effect on the thermal performance of air cooled gas turbine components, both with and without a ceramic thermal-barrier material, tested at reduced temperatures and pressures. The analysis shows that neglecting the material thermal conductivity can contribute significant errors when metal-wall-temperature test data taken on a turbine vane are extrapolated to engine conditions. This error in metal temperature for an uncoated vane is of opposite sign from that for a ceramic-coated vane. A correction technique is developed for both ceramic-coated and uncoated components. Author

N80-24578*# Aeronautical Research Associates of Princeton, Inc., N. J.
COMPUTATIONAL MODELS FOR THE VISCOUS/INVISCID ANALYSIS OF JET AIRCRAFT EXHAUST PLUMES Final Report
Sanford M. Dash, Harold S. Pergament, and Roger D. Thorpe May 1980 78 p refs
(Contract NAS1-14794)
(NASA-CR-3289; ARAP-408) Avail: NTIS HC A05/MF A01 CSCL 20D

Computational models which analyze viscous/inviscid flow processes in jet aircraft exhaust plumes are discussed. These models are component parts of an NASA-LaRC method for the prediction of nozzle afterbody drag. Inviscid/shock processes are analyzed by the SCIPAC code which is a compact version of a generalized shock capturing, inviscid plume code (SCIPPY). The SCIPAC code analyzes underexpanded jet exhaust gas mixtures with a self-contained thermodynamic package for hydrocarbon exhaust products and air. A detailed and automated treatment of the embedded subsonic zones behind Mach discs is provided in this analysis. Mixing processes along the plume interface are analyzed by two upgraded versions of an overlaid, turbulent mixing code (BOAT) developed previously for calculating nearfield jet entrainment. The BOATAC program is a frozen chemistry version of BOAT containing the aircraft thermodynamic package as SCIPAC; BOATAB is an afterburning version with a self-contained aircraft (hydrocarbon/air) finite-rate chemistry package. The coupling of viscous and inviscid flow processes is achieved by an overlaid procedure with interactive effects accounted for by a displacement thickness type correction to the inviscid plume interface. J.M.S.

N80-24579# Naval Postgraduate School, Monterey, Calif.
HEAT TRANSFER PERFORMANCE OF A ROTATING HEAT PIPE USING DIFFERENT CONDENSERS AND WORKING FLUIDS M.S. Thesis
Hans-Joachim Weigel Dec. 1979 57 p refs
(AD-A081805) Avail: NTIS HC A04/MF A01 CSCL 13/1

A rotating heat pipe was tested using five different copper condensers (a smooth cylinder, a spiral Noranda tube, two Hitachi tubes and a Turbotec tube) and three different working fluids (distilled water, ethanol and Freon 113). All condensers were tested with filmwise condensation at rotational speeds of 700, 1400, 2800 rpm. The heat transfer rate of each run was measured and plotted against the temperature difference between the vapor and the cooling water inlet. The main objective was to compare the different condenser configurations and working fluids with respect to the heat transfer achieved. The best heat transfer performance was achieved by using the spiral Noranda tube and distilled water as working fluid. With this tube rotating at 2800 rpm the heat pipe was capable of transferring 6.5 KW at a vapor temperature of 90 C. The maximum increase in performance of 300% over the smooth cylinder occurred when using the Turbotec tube and Freon 113 as working fluid. GRA

N80-24580# Naval Postgraduate School, Monterey, Calif.
AN EXPERIMENTAL STUDY OF FILMWISE CONDENSATION ON HORIZONTAL ENHANCED CONDENSER TUBING M.S. Thesis
Huseyin Ciftci Dec. 1979 171 p refs
(AD-A081603; NPS69-79-014) Avail: NTIS HC A08/MF A01 CSCL 13/1

Heat transfer and hydrodynamic performance of eight different geometrically enhanced tubes of different metals was determined. Results were compared to a 25.4 mm (1.0 in.) OD, smooth stainless steel tube. Steam at about 21 kPa (3 psia) was condensed on the outside surface of each enhanced tube, horizontally mounted in the center of a dummy tube bank. Each tube was cooled on the inside by water. The overall heat transfer coefficient was determined directly from experimental data. The inside and outside heat transfer coefficients were determined using the Wilson plot technique. The cooling water pressure drop was measured inside the tube and converted to the friction factor in the enhanced section. The overall heat transfer coefficients of the enhanced tubes were increased as much as 1.9 times, and the corrected pressure drops of the enhanced tubes were as large as 4 times the corresponding smooth tube value for the same cooling water velocity. The helix angle should be 45 deg to 60 deg on the inside surface and 90 deg on the outside surface of the tube to obtain maximum inside and outside heat transfer coefficients. GRA

N80-24581# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
THE INFLUENCE OF BLADE PROFILE AND SLOTS ON THE PERFORMANCE OF A CENTRIFUGAL IMPELLER [INFLUENCE DU PROFIL DE PALES ET FENTES SUR LA PERFORMANCE D'UN VENTILATEUR CENTRIFUGE]
H. S. Fowler Jan. 1980 44 p refs In ENGLISH; FRENCH summary
(AD-A082728; DME-ME-248) Avail: NTIS HC A03/MF A01 CSCL 20/4

As part of the program of studies on centrifugal impellers, the problem of instability at low flows was investigated. The major cause was found to be flow detachment from the impeller vanes. Slotted blades were found to be the most effective means of delaying this detachment, and extending the working range of the blower. Low speed studies were confirmed by a test program on a high speed machine, where it was demonstrated that the improved flow range was accompanied by a general increase of efficiency. The design and placement of the slots is discussed. GRA

N80-24582# United Technologies Research Center, East Hartford, Conn.
EXPERIMENTAL INVESTIGATION OF COMPRESSOR ROTOR WAKES Final Report, 1 Sep. 1977 - 30 Sep. 1979
Robert P. Dring, H. D. Joslyn, and L. W. Hardin Wright-Patterson AFB, Ohio AFAPL Jan. 1980 51 p refs
(Contract F33615-77-C-2083; AF Proj. 2307)
(AD-A081911; UTRC/R79-914183-15; AFAPL-TR-79-2107) Avail: NTIS HC A04/MF A01 CSCL 13/7

The detailed nature of the three dimensional flow downstream

of an isolated compressor rotor has been studied experimentally in a large scale rotating rig. Radial-circumferential arrays of pneumatic data have been acquired in the rotating frame for reference at values of (C sub x/U sub m) of 0.65, 0.75, 0.85 and 0.95 at planes 10, 30, 50 and 110% of blade axial chord aft of the rotor. The data consists of the total and static pressures and the yaw and pitch angles. From this data the relative velocity vector has been completely defined. From the data it can be seen that the radial flow in the wake increases dramatically as the rotor loading is increased (by going to lower values of (C sub x/U sub m)). At high values of (C sub x/U sub m) low total pressure fluid accumulates at the hub causing corner stall. As (C sub x/U sub m) is reduced, the radial flow carries the low total pressure fluid out to the tip, causing the hub corner stall to be inhibited, i.e. reduced in its streamwise extent aft of the blade trailing edge. By this process non-strip theory effects are seen to have a strong impact on the nature of rotor performance. GRA

N80-24583# Physical Sciences, Inc., Woburn, Mass.
ROUGH WALL REENTRY HEATING ANALYSIS. EFFECT OF SURFACE ROUGHNESS CHARACTER ON TURBULENT BOUNDARY LAYER HEATING Final Report, 1 Dec. 1977 - 30 Sep. 1979
M. L. Finson, A. S. Clarke, and P. K. S. Wu Feb. 1980 58 p refs Sponsored in part by Space and Missile Systems Organ.
(Contract F49620-78-C-0028; AF Proj. 2307)
(AD-A082438; PSI-TR-204; AFOSR-80-0251TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

A Reynolds stress model is used to evaluate the effect of surface roughness on turbulent boundary layers. Roughness is represented by distributed source or sink terms in the various governing equations, the most important term being a sink term in the mean momentum equation describing form drag on the roughness elements. The blockage effect of closely spaced elements is treated by accounting for the volume fraction occupied by the solid material. Calculations based on the theory have been compared with the available data on the influence of roughness character, where the roughness shape and spacing were varied. Reasonable agreement was obtained against most of Schlichting's low speed data with spherical, spherical segment, and conical roughness elements at various spacings. The cone measurements imply a somewhat higher effective drag coefficient than observed on the other shapes. The second set of experiments that were analyzed in detail were performed by Acurex under supersonic conditions, with a number of roughnesses created by grit or chemical etching processes. The heat transfer data and the present theory indicate spacing to be more important than height under the conditions tested. GRA

N80-24584# Pennsylvania State Univ., University Park. Applied Research Lab.
A THEORY FOR CAVITATION INCEPTION IN A FLOW HAVING LAMINAR SEPARATION
B. R. Parkin 19 Nov. 1979 187 p refs
(Contract N00024-79-C-6043)
(AD-A082851; ARL/PSU/TM-79-198) Avail: NTIS HC A09/MF A01 CSCL 20/4

An approximate theory is developed to predict onset of cavitation on hemispherical head forms for Reynolds numbers at which laminar separation is known to occur. Fairly good agreement is obtained between cavitation inception (or desinence) trends recently measured and the present theory which is based upon first principles as far as possible. Moreover, the observed occurrence of a lowest speed for 'bubble-ring' cavitation, which is the only cavitation form considered, and the range of (cutoff) speeds predicted by the present asymptotic theory show very encouraging agreement. Like the experiments, this theory suggests that the cutoff speed and its accompanying cutoff cavitation number can also depend on water temperature, provided that the initial size attributed to a 'typical' spherical free-stream air bubble nucleus also varies with temperature. At 80 F (26.6 C) it is found that the typical nucleus from which bubble-ring cavitation originates has a radius of about seven microns. At higher temperatures the nucleus radius decreases from this value while at lower temperatures the initial radius exceeds the value noted. It is also found that the onset cavitation number should be less than the magnitude of the pressure coefficient at the laminar separation point; and that the cavitation number increases with free-stream velocity. As long as there is an appreciable concentration of dissolved air in the water, it is also found that in agreement with experiment, the onset of bubble-ring cavitation is practically independent of air content. GRA

N80-24585# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
ON THE VERTICAL MOMENTUM OF THE FOUNTAIN PRODUCED BY MULTI-JET VERTICAL IMPINGEMENT ON A FLAT GROUND PLANE Final Report
K. T. Yen 1 Nov. 1979 27 p refs
(WR02302000)
(AD-A082765; NADC-79273-60) Avail: NTIS HC A03/MF A01 CSCL 20/4

An analysis of the vertical momentum flux for the fountain produced by multi-jet vertical impingement on a flat ground plane is presented. The jets are considered to have equal thrust and the same exit diameter, and to be equally-spaced on a bolt circle. Analytical formulas for both the core and arms of the fountain have been derived, and show the dependance on the height, planform size, and number of jets. Preliminary numerical comparison with some experimental data indicates the formulas to be capable to produce acceptable predictions. Comparison has also been made with Kuhn's empirical formulas, revealing some similarity as well as differences between the two sets of formulas. Additional work needed for the development of prediction methods for lift losses is suggested. GRA

N80-24586# State Univ. of New York at Buffalo. Fluid and Thermal Science Lab.
STABILITY AND TRANSITION OF WALL BOUNDARY LAYERS INDUCED BY MOVING WAVES Final Report, 15 May 1974 - 14 May 1979
J. Gordon Hall and Yehia Mamoud Amr Jul. 1979 160 p refs
(Grant AF-AFOSR-2719-74; AF Proj. 2307)
(AD-A082534; AFOSR-80-0231TR) Avail: NTIS HC A08/MF A01 CSCL 20/4

The present study concerns a theoretical investigation of stability and an experimental investigation of transition for wall boundary layers developed within unsteady plane expansion waves and behind shock waves traveling into a gas at rest. The theoretical investigation involved three tasks: the use of approximate methods for the prediction of critical Reynolds numbers, a numerical integration of the ORR-Sommerfeld equation for the incompressible boundary layer flow at the expansion wave head, and the development of a multiple scales technique for nearly quasi-steady, quasi-parallel boundary layer flows. The boundary layer flow at expansion wave head has the same velocity profile as a semi-infinite flat plate given a sudden constant acceleration after being at rest. Expansion wave boundary layer transition times observed after the time of wave head arrival, are five to eight times larger than those previously reported and most of the transition Reynolds numbers observed are above or near the critical Reynolds numbers calculated by the approximate method. Shock wave boundary layer transition times observed are also larger than those previously reported and some of the transition Reynolds numbers observed based on distance to the shock wave front are above the critical values previously calculated. GRA

N80-24587# Clemson Univ., S.C. Dept. of Mechanical Engineering.
THREE-DIMENSIONAL TRANSIENT NATURAL CONVECTION IN A HORIZONTAL CYLINDER: A NUMERICAL ANALYSIS Final Report 18 May - 31 Dec. 1979
James A. Liburdy Feb. 1980 38 p refs
(Contract F49620-79-C-0168; AF Proj. 2307)
(AD-A082858; AFOSR-80-0262TR) Avail: NTIS HC A03/MF A01 CSCL 20/13

A mathematical formulation of the governing equations for transient natural convection in a finite length horizontal cylinder is developed and constructed in finite difference form. The boundary conditions consist of radial heat flux for a specified thermal resistance, axial heat flux from one closed end and three different conditions at the other end to represent exposure to a hot convecting gas environment. The formulation is expressed

in terms of the vorticity equations, energy equation and a set of vector potential equations. Solution is by the alternating direction implicit method for the vorticity and energy equations and the successive over relaxation method for the vector potential equations. Numerical experiments were run using the model to determine the local wall heat flux and the local wall temperatures. A heat transfer correlation is presented in terms of the Nusselt and Rayleigh numbers. Steady state conditions are obtained for the nondimensional time approximately equal to .005. Circumferential heat transfer coefficient variations are shown with larger values occurring near the top of the cylinder. Axial coefficients vary within approximately 10 percent with the largest values occurring near the center of the cylinder. With respect to test conditions at the AEDC facility, the convective components appear to be less than 10 percent of the radiative heat flux to the cylinder walls when a high temperature gas (air) is enclosed in the cylinder. GRA

N80-24588# AiResearch Mfg. Co., Torrance, Calif.
HIGH-TEMPERATURE CERAMIC HEAT EXCHANGER Final Report
M. Coombs, D. Kotchick, and H. Warren Jul. 1979 366 p refs Sponsored by Elec. Power Res. Inst.
(EPRI-FP-1127) Avail: NTIS HC A16/MF A01

A ceramic heat exchanger for operation with a small, closed Brayton cycle engine was developed which operates with 3000 F combustion products on one side and heats high pressure Argon gas, which subsequently is delivered to the turbine, to 1800 F. A materials test program encompassing strength tests, cyclic fatigue tests, and stress rupture tests from room temperature to a maximum of 2950 F was conducted on various silicon carbide test specimens. Complete heat exchanger modules were produced and tested under simulated engine operating conditions up to 2300 F tube wall temperatures. The design consisting of an array of siliconized silicon carbide U tube modules employing 180, 1 inch diameter finned tubes was selected. DOE

N80-24589# Oak Ridge National Lab., Tenn. Chemistry Div.
THERMAL MOTION ANALYSIS
C. K. Johnson 1980 16 p refs
(Contract W-7405-eng-26)
(DOE/TIC-11068) Avail: NTIS HC A02/MF A01

The items selected for coverage reflect what can be determined from thermal motion studies using Bragg diffraction data. The emphasis is on rigid body and segmented body thermal motion analysis, the effects of internal molecular vibration on vibration ellipsoids, and a practical model for anharmonic vibration analysis. A quasi-orthogonal model for higher order atomic thermal motion is described. A least squares program incorporating that model has been in use since 1971 and has a history of successful application to difficult problems such as ionic conductors. DOE

N80-24590# Sandia Labs., Albuquerque, N. Mex.
CORRELATION OF NOSETIP BOUNDARY-LAYER TRANSITION DATA MEASURED IN BALLISTICS-RANGE EXPERIMENTS
D. C. Reda Nov. 1979 61 p refs
(Contract EY-76-C-04-0789)
(SAND-79-0649) Avail: NTIS HC A04/MF A01

Preablated nosetips of various carbonaceous materials were tested in a ballistics range. Surface-temperature contours, measured with image-converter cameras were used to define boundary-layer transition-front contours. Measurements of surface roughness, surface temperature, average transition-front location, and freestream environment were combined with calculations of nosetip flowfields, and with calculations of laminar boundary-layer development in these flowfields, to transform all data into various dimensionless parameters. These parameters were defined by previous attempts to correlate existing wind-tunnel data for transition on rough/blunt bodies. Of the available correlating techniques, only one, based on the concept of a constant (critical) roughness Reynolds number for transition, was found to successfully describe both the wind-tunnel and ballistics-range data. DOE

N80-24591# Royal Aircraft Establishment, Farnborough (England).
THE STRUCTURE OF THE DOPPLER-DIFFERENCE SIGNAL AND THE ANALYSIS OF ITS AUTOCORRELATION FUNCTION
J. B. Abbiss London HMSO Jul. 1979 25 p refs Repr. from Phys. Scripta (Sweden), v. 19, 1979 p 388-395
(RAE-TR-79089; RAE-IT-165; BR71041) Avail: NTIS HC A02/MF A01

The essential characteristics of the Doppler-difference signal and of the associated autocorrelation function are considered for both laminar and turbulent flows. Experimental conditions under which it is known that the autocorrelation function can be analyzed to yield reliable estimates of mean velocity and turbulence intensity are specified. The various data reduction methods which are proposed are classified and briefly reviewed. It is shown that unknown flows having relatively high levels of turbulence can only be treated successfully is there are very many fringes within a beam diameter, or if frequency-shifting techniques are used to achieve an equivalent effect. The estimation of turbulence intensity in low turbulence flows also presents special difficulties and a procedure which uses information already available in the transform plane is described. Author (ESA)

N80-24592# Royal Aircraft Establishment, Farnborough (England).
MEASUREMENTS OF THE TURBULENCE AHEAD OF 45 DEG SWEPT STEP USING A DOUBLE SPLIT-FILM PROBE
L. F. East and W. G. Sawyer London HMSO Nov. 1979 39 p refs
(RAE-TR-79136; RAE-Aero-3486; BR71441) Avail: NTIS HC A03/MF A01

Initial data obtained with a special double split-film probe in the boundary layer flow ahead of a 45 deg swept step show that the probe offers a convenient means of measuring the three velocity components of turbulence. It is also shown, that the measurements are not reliable within about 15 mm of the surface. The measurements indicate that the rotation of the shear stress vector as the flow develops lags considerably behind the rotation of the velocity gradient. Author (ESA)

N80-24593# Geological Survey, Menlo Park, Calif. Water Resources Div.
DOCUMENTATION OF A FINITE-ELEMENT TWO-LAYER MODEL FOR SIMULATION OF GROUNDWATER FLOW Final Report
Michael J. Mallory Aug. 1979 353 p refs Prepared in cooperation with San Bernardino Valley Municipal Water District, Calif.
(PB80-140932; USGS/WRI-79-18; USGS/WRD/WRI-80/008) Avail: NTIS HC A16/MF A01 CSCL 08H

A finite element model is documented for simulation of ground water flow in a two-aquifer system where the two aquifers are coupled by a leakage term that represents flow through a confining layer separating the two aquifers. The computer program, FORTRAN 4 computer language, is described in detail. GRA

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *05 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N80-24594*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SCANNING LASER-VELOCIMETER TECHNIQUE FOR MEASURING TWO-DIMENSIONAL WAKE-VORTEX VELOCITY DISTRIBUTIONS
Luther R. Gartrell and David B. Rhodes 23 May 1980 43 p refs
(NASA-TP-1661; L-13426) Avail: NTIS HC A03/MF A01 CSCL 14B

A rapid scanning two dimensional laser velocimeter (LV)

has been used to measure simultaneously the vortex vertical and axial velocity distributions in the Langley Vortex Research Facility. This system utilized a two dimensional Bragg cell for removing flow direction ambiguity by translating the optical frequency for each velocity component, which was separated by band-pass filters. A rotational scan mechanism provided an incremental rapid scan to compensate for the large displacement of the vortex with time. The data were processed with a digital counter and an on-line minicomputer. Vaporized kerosene (0.5 micron to 5 micron particle sizes) was used for flow visualization and LV scattering centers. The overall measured mean-velocity uncertainty is less than 2 percent. These measurements were obtained from ensemble averaging of individual realizations. Author

N80-24595*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DYNAMIC BEHAVIOR OF A BEAM DRAG-FORCE ANEMOMETER
Gustave C. Fralick Washington May 1980 16 p refs
(NASA-TP-1687; E-340) Avail: NTIS HC A02/MF A01 CSCL 14B

A cantilevered beam with strain gages attached to the fixed ends and the minimax technique were used in an experiment conducted to determine the dynamic behavior of a drag-force anemometer in high frequency, unsteady flow. In steady flow the output of the anemometer is proportional to stream velocity head and flow angle. Fluid mechanics suggests that, in unsteady flow, the output would also be proportional to the rate of change of fluid velocity. It was determined that effects due to the rate of change of fluid velocity are negligible for the probe geometry and frequencies involved. A.R.H.

N80-24596# Defence Research Establishment Suffield, Ralston (Alberta).
DYNAMIC SIMULATION OF A CANTILEVER BEAM TYPE FORCE TRANSDUCER
D. A. Bayly Feb. 1980 60 p refs
(AD-A082314; DRES-TN-440) Avail: NTIS HC A04/MF A01 CSCL 02/1

A cantilever beam force transducer was modelled as a massless elastic section at the base with the remaining section of the beam rigid and having mass. Computer programs were written to simulate free or forced, damped or undamped vibrations of the beam. Good agreement was found between predicted and experimental frequencies of undamped free vibration for two different beams. After further verification, the computer programs can be used to determine beam configurations, viscous damping factors, and loading rates which will reduce unwanted oscillations of the transducer element. GRA

N80-24597# Weizmann Inst. of Science, Rehovoth (Israel).
DEVELOPMENT OF RECORDING MATERIALS FOR HOLOGRAPHIC NON-DESTRUCTIVE TESTING Final Report, 1 Jun. 1978 - 30 Aug. 1978
A. A. Friesem and S. Reich Aug. 1979 68 p refs
(Grants AF-AFOSR-3421-77; AF-AFOSR-3004-76; AF Proj. 2307)
(AD-A082030; AFFDL-TR-79-3089) Avail: NTIS HC A04/MF A01 CSCL 14/2

This report describes a two year effort on investigating two recording materials for in-situ, real-time holographic nondestructive field testing application, namely, photodielectrics and photoconductor thermoplastic devices (PC-TP). The holographic parameters as well as the recording mechanism of photo-dielectric materials were thoroughly studied. The recording mechanism is attributed to photochemically induced cross links of macromolecules. Resolution on excess of 2500 1/mm and diffraction efficiency approaching 100% were measured. Due to the low exposure sensitivity, about 1 J/sq cm, this recording material could only be incorporated into systems for testing relatively small objects. A number of ways for operating the PC-TP devices more reliably and for improving the spatial bandwidth to over 1800 1/mm were established. Furthermore, the frost formation mechanism was investigated, and means for supressing the frost were determined, thereby leading to improved signal-to-noise ratio. These results together with the high exposure sensitivity (50 erg/sq cm and the improvements in sample fabrication, have led to an operable device which may be incorporated into most holographic non-destructive systems. GRA

N80-24598# Stanford Univ., Calif. Dept. of Physics.
MODELING AND ERROR ANALYSIS OF A SUPERCONDUCTING DUCTING GRAVITY GRADIOMETER Final Report
Kai Yuen Wang Aug. 1979 284 p refs
(Grant AF-AFOSR-2913-76; AF Proj. 2309)
(AD-A082535; AFOSR-80-0219TR) Avail: NTIS HC A12/MF A01 CSCL 17/7

The demand for higher accuracy in inertial navigation systems has pushed the development of more accurate accelerometers and gyroscopes. Inertial navigation systems (INS) can now be built with error stemming mainly from the uncertainty of the vertical along the flight path (Savet, 1970). The deflection of the vertical is produced by mass anomalies on the surface of the earth. The error can be corrected by measuring the gravity gradient and using it in the navigation equations. This possibility has generated intensive interest and research in the field of gravity gradiometry. The lower bound of the resolution of room temperature gravity gradiometers is thermal (Brownian) noise. By lowering the temperature to 4 K, the noise level is smaller by an order of magnitude. A comparatively simple gravity gradiometer can be built using some newly developed superconducting technology. GRA

N80-24599# United Nuclear Industries, Inc., Richland, Wash.
ULTRASONIC FLOWMETERS Progress Report
W. D. Wittekind 12 Nov. 1979 58 p refs
(Contract EY-76-C-06-1857)
(UNI-1405) Avail: NTIS HC A04/MF A01

A prototype ultrasonic flowmeter was assembled and tested. The theoretical basis of this prototype ultrasonic flowmeter is reviewed. The equipment requirements for a portable unit, the individual electronic modules contained in the prototype, and the operating procedures and configuration are explained. The data from preliminary calibrations are presented. The calibration data confirm that the prototype operates according to theoretical prediction and provides nonintrusive flow measurements to predicted accuracies for pipes larger than two inches, under single phase stable flow conditions. DOE

N80-24600# United Nuclear Industries, Inc., Richland, Wash.
ULTRASONIC FLOWMETERS Interim Progress Report
W. D. Wittekind and H. Toffer 31 Jan. 1979 28 p refs
(Contract EY-76-C-06-1857)
(UNI-1318) Avail: NTIS HC A03/MF A01

Ultrasonic flow measuring and flow characterization methods for use in flows of primary coolant, secondary water, and auxiliary water systems are examined. The major advantage of these methods is that they do not require penetration or alteration of the fluid containment structure. An evaluation of commercially available equipment is given and testing of the equipment is described. DOE

36 LASERS AND MASERS

Includes parametric amplifiers.

N80-24601 Columbia Univ., New York.
A COLLECTIVE FREE ELECTRON LASER Ph.D. Thesis
David Bruce McDermott 1979 146 p
Avail: Univ. Microfilms Order No. 8009686

A tunable, free electron laser operated in the stimulated Raman scattering regime is discussed. An intense relativistic electron beam (1.2MV,25kA) propagating in a rippled magnetic field scattered megawatt level radiation at sub-millimeter wavelengths (400 microns). The performance of the device is determined by the pulse length of the accelerator and its voltage fluctuation. With high fluctuation disruption of the three-wave resonance can occur, and the radiation is absorbed by the electrons. The general scattering processes of a cold e-beam are discussed in the theoretical section. The model not only describes the immediate experiment, but also has ramifications for the earlier experiments which collective effects were assumed

negligible. The oscillating two-stream instability contributed to their observed gain. A reformulation of three-wave scattering where the space charge wave has assumed the role of the idler is also presented, and an original derivation of the parametric growth rate for scattering with the electromagnetic cyclotron wave as idler. Dissert. Abstr.

N80-24602*# National Aeronautics and Space Administration. Pasadena Office, Calif.
COHERENTLY PULSED LASER SOURCE Patent Application
Jack S. Margolis, inventor (to NASA) (JPL) Filed 15 May 1980 12 p
(Contract NAS7-100)
(NASA-Case-NPO-15111-1; US-Patent-Appl-SN-150040) Avail: NTIS HC A02/MF A01 CSCL 20E

An electronically controllable apparatus is described which modulates a continuous wave laser beam so as to produce an output beam consisting of coherent 'pulses' that are electronically controllable as to both pulse repetition rate and pulse width. The apparatus includes two acoustic devices positioned so that the laser beam passes through them in sequence, and an apparatus for passing sound waves through the devices to frequency shift the laser radiation as well as to diffract it. Each acoustic device generates sound waves containing a group of frequencies which result in spaced pulses. The spreading of a laser beam which emanates from the first acoustic device is countered by the second acoustic device to produce a collimated, coherently pulses, laser beam. NASA

N80-24603*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Science.
ANALYSIS OF LUNAR LASER RANGING DATA FOR EARTH DYNAMICS APPLICATIONS Final Report
Charles C. Counselman, III 31 Jan. 1980 9 p
(Grant NsG-7428)
(NASA-CR-163145) Avail: NTIS HC A02/MF A01 CSCL 20E

The effects of elasticity and of tidal friction within the Moon were incorporated into the numerical model of the Moon's rotation which was used in an effort to determine the axial rotation of the Earth, as measured by Universal Time. Some 2,651 normal points representing ranges measured to Lunokhod 2, and to the Apollo 11, 14, and 15 retroflectors were analyzed. Smoothed estimates derived from the lunar rangefinding were compared with smoothed values published by the International Bureau of Time, in the 1968 and 1969 systems. The derived values at the observation sight were connected to corresponding values at the Conventional International Origin, using the BIH data for polar motion. Differences are discussed. A.R.H.

N80-24604*# Stanford Univ., Calif. Labs. of Physics.
STUDIES OF LASER AND LASER DEVICES Final Report, 1 Apr. 1979 - 31 Mar. 1980
S. E. Harris, A. E. Siegman, and J. F. Young May 1980 34 p refs
(Grant NsG-7619)
(NASA-CR-163144; SU-GL-3132) Avail: NTIS HC A03/MF A01 CSCL 20E

The generation of tunable, infrared, and ultraviolet light, and the control of this light by mode-locking and modulation techniques are discussed. Particular emphasis is given to energy storage and extraction using atomic levels, the development of a tunable narrowband vacuum ultraviolet light source, and to the generation and applications of ultrashort optical pulses. A.R.H.

N80-24605# Textron Bell Aerospace Co., Buffalo, N. Y.
NUMERICAL MODEL DEVELOPMENT FOR LASER CAVITY FLOWFIELDS Interim Report, 31 May 1979 - 31 May 1979
J. T. Schimke 1979 64 p refs
(Contract F49620-77-C-0076; AF Proj. 2304)
(AD-A078297; Rept-9278-950002; AFOSR-79-1239TR) Avail: NTIS HC A04/MF A01 CSCL 20/5

A recently developed subroutine package for the integration of systems of ordinary differential equations by implicit methods is tested on a variety of gas dynamic problems. These problems include one dimensional unsteady gas flow with chemistry and radiation and two and three dimensional parabolic (steady) Navier-Stokes problems. The governing partial differential equations were converted to systems of ordinary differential equations using either finite differences or finite elements, and then integrated by the implicit integration package. GRA

N80-24606# United Technologies Research Center, East Hartford, Conn.
ELECTRON-BEAM-SUSTAINED BLUE/GREEN LASER PUMP Final Technical Report
R. T. Brown and W. L. Nighan Feb. 1980 46 p refs
(Contract N00014-78-C-0830)
(AD-A081423; UTRC/R80-924428-1) Avail: NTIS HC A03/MF A01 CSCL 07/4

Techniques are described for prolonging the duration of stable E-beam controlled excimer laser discharges, including: temporal tailoring of either the discharge voltage or the ionization source, and kinetics modification by way of additives. Theoretical and experimental results are presented for Kr F* discharges. The Xe Cl (B) formation processes are examined for conditions typical of a discharge excited laser using HCl as the chlorine donor. It is shown that vibrational excitation of HCl followed by dissociative attachment is a primary step in the reaction sequence resulting in Cl(-). Formation of XeCl(B) is the result of a three body Xe(+) - Cl(-) recombination reaction. Experimental results are presented which demonstrate (approx. 2%) Xe Cl laser operation in an e-beam assisted discharge in which over 75% of the energy was deposited by the discharge. GRA

N80-24607# General Electric Co., Philadelphia, Pa. Space Div.
DESIGN STUDY OF A LASER RADAR SYSTEM FOR SPACEFLIGHT APPLICATION Final Report, 7 Sep. 1978 - 7 Dec. 1979
W. F. Brahm and J. L. Buckley Dec. 1979 249 p refs
(Contract F19628-78-C-0204; AF Proj. 6690)
(AD-A082332; AFGL-TR-79-0264) Avail: NTIS HC A11/MF A01 CSCL 04/1

This report provides the analyses of several laser measurement techniques for the determination of the density of the neutral atmosphere from space. Several operational concepts of a laser radar system for spaceflight applications were investigated, including also, a proof-of-concept balloon-based experiment. The recommended baseline density measurement technique uses two wavelengths and the wavelength dependence of Rayleigh scattering (1/lambda to the 4th power) and Mie scattering (about 1/lambda) to separate the neutral atmosphere returns from those of aerosols and particulates. GRA

N80-24608# Calspan Advanced Technology Center, Buffalo, N.Y. Aerodynamic Research Dept.
MEASUREMENT OF KINETIC RATES FOR CARBON MONOXIDE LASER SYSTEMS Final Scientific Report, Oct. 1978 - 30 Oct. 1979
J. W. Rich, R. C. Bergman, and M. J. Williams Nov. 1979 111 p refs
(Contract F49620-77-C-0020; AF Proj. 2301)
(AD-A082345; CALSPAN-WG-6021-A-3; AFOSR-80-0207TR) Avail: NTIS HC A06/MF A01 CSCL 20/10

A continuous wave carbon monoxide laser is used to excite the vibrational mode of CO in gas mixtures flowing through an absorption cell. High steadystate excitation of the CO vibrational mode (0.3 eV/molecule) is achieved, while a translational-rotational temperature near 300 K is maintained by the steady flow of cold gas into the cell. These non-equilibrium conditions result in extreme vibration - vibration pumping populating high-lying vibrational quantum levels (to V = 42) of CO. N2 can also be pumped by vibrational energy transfer from CO. Using the experimental technique, the vibration-translation (V-T) deactivation rates for high vibrational quantum levels of carbon monoxide have been measured for collisions of carbon monoxide with argon at room temperature. The rates are quantum-state-resolved and have been measured for quantum levels from V = 10 up 10 v = 42. GRA

N80-24609# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
HEL PHASE CONTROL
Kenneth W. Kaiser Sep. 1979 90 p refs

(Contract DAAK40-78-C-0117)
(AD-A081917; R-1303) Avail: NTIS HC A05/MF A01 CSCL 20/5

This report summarizes progress toward a solution to the problem of HEL control-loop instability in the presence of thermal blooming. Current phase-control-loop structure is analyzed, and a dual-loop structure is proposed. A corresponding closed-loop phase-compensation control algorithm is also proposed, and its fundamental requirements identified. Because the key subsystem impacted by the control algorithm is the HEL deformable mirror, considerable attention is paid to adaptive-optics deformable-mirror requirements for both continuous-wave and pulsed lasers. GRA

N80-24610# Colorado State Univ., Fort Collins. Dept. of Chemistry.
LASER SPECTROSCOPIC STUDIES OF MOLECULAR CRYSTALS Final Report, 1 Jun. 1975 - 30 Nov. 1979
Elliot R. Bernstein Mar. 1980 7 p
(Contract N00014-75-C-1179; NR Proj. 056-607)
(AD-A082334) Avail: NTIS HC A02/MF A01 CSCL 20/5

This report summarizes the work performed under the contract from 1 June 1975 to 30 November 1979. It includes a summary of new results, a list of all technical reports generated during the life of the contract, and a listing of personnel associated with the project. GRA

N80-24611# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
STUDY OF LASER CREATED METAL VAPOR PLASMAS Final Technical Report, 1 Oct. 1978 - 30 Sep. 1979
R. M. Measures 16 Nov. 1979 71 p refs
(Grant AF-AFOSR-2902-76; AF Proj. 2301)
(AD-A082215; AFOSR-80-0193TR) Avail: NTIS HC A04/MF A01 CSCL 20/9

During the past year the 'Laser Ablation and Selective Excitation Spectroscopy' facility has been extended to provide a dual wavelength excitation and monitoring capability. Work on an experiment, that is directed at making the first direct spatially and temporally resolved measurements of the ion to neutral ground state population ratio in a laser ablation plasma, has recently been commenced. The preliminary results attained to date have been encouraging. GRA

N80-24612# Toronto Univ. (Ontario). Dept. of Chemistry.
STUDY IN MOLECULAR LASERS Final Technical Report, 1 Jun. 1975 - 15 Dec. 1979
George Burns 11 Feb. 1980 14 p refs
(Grant AF-AFOSR-2856-75)
(AD-A081982; AFOSR-80-0181TR) Avail: NTIS HC A02/MF A01 CSCL 20/5

Chemical reactions important in molecular lasers were studied with a special emphasis on atomic recombinations and on dissociation of diatomic molecules. The experiments involved flash photolysis and shock wave techniques. The results were explained in terms of 3-D trajectory calculations. GRA

N80-24613# Army Missile Command, Redstone Arsenal, Ala. High Energy Research Lab.
CUMULATIVE REACTANT SPECIES INDEX FOR VOLUMES 1-5 OF THE COMPILATION OF DATA RELEVANT TO GAS LASERS, VOLUME 6
E. W. McDaniel, M. R. Flannery, E. W. Thomas, H. W. Ellis, K. J. McCann, S. T. Manson, J. W. Gallagher, S. R. Rumble, E. C. Beaty, and T. G. Roberts Sep. 1979 143 p Prepared in cooperation with Georgia Inst. of Technol., Atlanta, Georgia State Univ., Atlanta, and Colorado Univ., Boulder
(AD-A082665; DRSMI-H-78-1-Vol-6) Avail: NTIS HC A07/MF A01 CSCL 20/5

This volume contains a cumulative reactant species index for MIRADCOM Technical Report H-78-1. Volumes 1 and 2 covered data relevant to rare gas monohalide excimer lasers. Volumes 3-5 covered data relevant to nuclear pumped lasers. GRA

N80-24614# Memphis State Univ., Tenn. Inst. for Engineering Reserach.
INVESTIGATION OF THE PULSE-TO-PULSE PHASE COHERENCE OF CARBON DIOXIDE LASERS Final Report, 15 Jan. 1979 - 14 Jan. 1980
Carl E. Halford Jan. 1980 28 p refs
(Grant DAAG29-79-C-0018)
(AD-A082613; ARO-16279.2-R-P) Avail: NTIS HC A03/MF A01 CSCL 20/5

The phase coherence properties of pulsed carbon dioxide lasers are analyzed. Experimental results for a self-pulsing helium neon ring laser are presented and used to calculate the average phase coherence time for that system. Experimental factors are the primary limitations for phase coherence. These factors influence the phase by altering the resonant cavity by mirror motion or by index of refraction changes. The importance of these two factors are assessed for high power TEA lasers using the experimental results of others. A novel technique of active phase correction for correcting the phase of pulsed lasers is presented. GRA

N80-24615# Harry Diamond Labs., Adelphi, Md.
ASSESSMENT OF Pr(3+):KY3F10 AS A BLUE-GREEN LASER
Clyde A. Morrison, Donald F. Wortman, Richard P. Leavitt, and Hans P. Jenssen Feb. 1980 28 p refs
(Contract MIPR-78-MP-90020)
(AD-A082982; HDL-TR-1897) Avail: NTIS HC A03/MF A01 CSCL 20/5

The reported energy levels of praseodymium and europium in the host material KY3F10 have been analyzed. Using the X-ray data, lattice sums have been done, and odd crystal-field parameters have been calculated. Using these results, the transition probabilities for both magnetic and electric dipoles have been calculated for the rare earth ions. Discussions are given of the application of the results to a blue-green laser using praseodymium. GRA

N80-24616# Smithsonian Astrophysical Observatory, Cambridge, Mass.
A STUDY OF CRYOGENIC TECHNIQUES FOR OPERATING HYDROGEN MASERS Interim Report, 1 Jul. 1979 - 31 Jan. 1980
Robert F. C. Nessot Feb. 1980 7 p
(Contract N00014-77-C-0777)
(AD-A082937) Avail: NTIS HC A02/MF A01 CSCL 20/13

Cryogenic Techniques are applied to the Atomic Hydrogen Maser Frequency Standard to extend the storage time of the atoms and reduce the thermal noise accompanying the signal and within the resonance linewidth. Oscillation has been achieved below 25 K using wall coatings of frozen CF4. A pair of new masers is under construction so that frequency stability improvement can be measured. Stability at the 10 to the -16th power level in Delta f/f for averaging time intervals of 1,000 seconds is expected at temperatures below 30 K. GRA

N80-24617# California Univ., Livermore. Lawrence Livermore Lab.
EXPERIMENTS WITH POLYMER COATED MICROSPHERES IRRADIATED BY THE SHIVA LASER SYSTEM
J. M. Auerbach, K. R. Manes, D. L. Matthews, L. N. Koppel, S. M. Lane, E. M. Campbell, N. Ceglio, D. Phillion, P. .t. Y. Lee, V. Rupert et al 10 Nov. 1979 18 p refs Presented at the 21st Ann. Meeting of the Am. Phys. Soc., Boston, 12-16 Nov. 1979 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-83057; CONF-791135-2) Avail: NTIS HC A02/MF A01

Polymer coated spherical targets were irradiated by the Shiva laser system in an effort to compress the contained 10 mg/cc DT fuel to super liquid densities. Glass microspheres of 140 micron ID and 5 micron wall thickness with polymer coatings 15 micron to 100 micron thick were irradiated with laser pulses of 4 kilojoules in 200 psec FWHM. Target performance was diagnosed with neutron yield measurements, radiochemistry, Argon line imaging, and X-ray imaging techniques. Ball in plate targets achieved greater implosion symmetry than free standing ball targets. With yields of ten million to one hundred million neutrons, targets reached DT fuel compressions of several times liquid density. DOE

N80-24618# Los Alamos Scientific Lab., N. Mex.
PLANAR STREAK CAMERA LASER-DRIVEN SHOCKWAVE STUDIES
L. R. Veeser, A. J. Lieber, and J. C. Solem 1979 6 p refs Presented at the Intern. Conf. on Lasers, Orlando, Fla., 17-21 Dec. 1979
(Contract W-7405-eng-36)
(LA-UR-79-3509; CONF-791220-3) Avail: NTIS HC A02/MF A01

High pressure equation-of-state parameter determination is now possible using a high-energy laser to drive shock waves into a multiple foil target. Progress in the design of streak cameras and targets has reduced the errors and uncertainties in impedance-match measurements to about 5 to 10%, and further improvements are expected in the near future. Initial measurements are reported for pressures in the few-megabar region for gold and aluminum. DOE

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N80-24619*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FULLY PLASMA-SPRAYED COMPLIANT BACKED CERAMIC TURBINE SEAL Patent Application
R. C. Bill, inventor (to NASA) Filed 30 Apr. 1980 7 p
(NASA-Case-LEW-13268-1; US-Patent-Appl-SN-145209) Avail: NTIS HC A02/MF A01 CSCL 11A

To maintain the minimum operating clearances between the blade tips and the lining of a high pressure turbine, a low temperature easily decomposable material, such as a polymer, in powder form is blended with a high temperature oxidation resistant metal powder. The two materials are simultaneously deposited on a substrate formed by the turbine casing. Alternately, the polymer powder may be added to the metal powder during plasma spraying. A ceramic layer is then deposited directly onto the metal-polymer composite. The polymer additive mixed with the metal is then completely volatilized to provide a porous layer between the ceramic layer and the substrate. Thermal stresses are reduced by virtue of the resulting porous structure which affords a cushion effect. By using plasma spraying for depositing both the powders of the metal and polymer material, as well as the ceramic powder, no brazing is required. NASA

N80-24620*# Chrysler Corp., Detroit, Mich.
BASELINE AUTOMOTIVE GAS TURBINE ENGINE DEVELOPMENT PROGRAM Final Report
C. E. Wagner, ed. and R. C. Pampreen, ed. Apr. 1979 182 p refs Sponsored by NASA
(Contracts EY-76-C-02-2749; EC-77-A-31-1040)
(NASA-CR-159670; DOE/NASA/2749-79/1-Vol-1; C00-2749-42) Avail: NTIS HC A09/MF A01 CSCL 21A

Tests results on a baseline engine are presented to document the automotive gas turbine state-of-the-art at the start of the program. The performance characteristics of the engine and of a vehicle powered by this engine are defined. Component improvement concepts in the baseline engine were evaluated on engine dynamometer tests in the complete vehicle on a chassis dynamometer and on road tests. The concepts included advanced combustors, ceramic regenerators, an integrated control system, low cost turbine material, a continuously variable transmission, power-turbine-driven accessories, power augmentation, and linerless insulation in the engine housing. R.E.S.

N80-24621*# Chrysler Corp., Detroit, Mich.
CONCEPTUAL DESIGN STUDY OF AN IMPROVED AUTOMOTIVE GAS TURBINE POWERTRAIN Final Report
C. E. Wagner, ed. and R. C. Pampreen, ed. Jun. 1979 196 p refs
(Contracts DE-AC02-76CS-52749)
(NASA-CR-159672; DOE/NASA/2749-79/3-Vol-3; C00-2749-40) Avail: NTIS HC A09/MF A01 CSCL 21A

Automotive gas turbine concepts with significant technological advantages over the spark ignition (SI) engine were assessed. Possible design concepts were rated with respect to fuel economy and near-term application. A program plan which outlines the development of the improved gas turbine (IGT) concept that best met the goals and objectives of the study identifies the research and development work needed to meet the goal of entering a production engineering phase by 1983. The fuel economy goal is to show at least a 20% improvement over a conventional 1976 SI engine/vehicle system. On the basis of achieving the fuel economy goal, of overall suitability to mechanical design, and of automotive mass production cost, the powertrain selected was a single-shaft engine with a radial turbine and a continuously variable transmission (CVT). Design turbine inlet temperature was 1150 C. Reflecting near-term technology, the turbine rotor would be made of an advanced superalloy, and the transmission would be a hydromechanical CVT. With successful progress in long-lead R&D in ceramic technology and the belt-drive CVT, the turbine inlet temperature would be 1350 C to achieve near-maximum fuel economy. A.R.H.

N80-24622*# California State Univ., Northridge. School of Engineering and Computer Science.
STUDY OF ROLLING ELEMENT DYNAMIC INTERACTIONS WITH SEPARATOR AND RACEWAY PATHS. ROLLER SKEWING MEASUREMENTS IN ROLLER BEARINGS Final Report
Lester J. Nypan 21 May 1980 108 p refs
(Grant NsG-3065)
(NASA-CR-163186) Avail: NTIS HC A06/MF A01 CSCL 13I

Measurements of roller skewing in a 118 mm bore roller bearing operating at shaft speeds to 12000 rpm are reported. High speed motion pictures of a modified roller were taken through a derotation prism to record skewing as the roller moved through loaded and unloaded regions of the bearing. Subsequent frame by frame measurement of the photographic film provided information on roller skewing. Radial and tangential skew amplitudes of .4 to .5 degrees were observed with .5 degree misalignment. Author

N80-24623# Norton Co., Worcester, Mass. Industrial Ceramics Div.
SEVERE ENVIRONMENT TESTING OF SILICON NITRIDE ROLLING ELEMENTS Final Report, 30 Dec. 1977 - 2 Mar. 1979
John W. Lucek, L. B. Sibley, and J. W. Rosenlieb Nov. 1979 82 p refs Prepared in cooperation with SKF Industries, Inc., King of Prussia, Pa.
(Contract N00019-77-C-0551)
(AD-A080801) Avail: NTIS HC A05/MF A01 CSCL 13/8

Wear rates for dry film lubricated rolling-spinning contacts of silicon nitride surfaces were studied to 540 C wear rate was essentially constant to 315 C. Surface stress modifications in hot pressed silicon nitride have been shown to improve tensile stress behavior under high magnitude Hertzian stress fields.GRA

N80-24624# Aerodyne Dallas, Tex.
TURBOCHARGING OF SMALL INTERNAL COMBUSTION ENGINES AS A MEANS OF IMPROVING ENGINE/APPLICATION SYSTEM FUEL ECONOMY Final Report
1979 202 p refs
(Contract DAAK07-78-C-0031)
(AD-A081442) Avail: NTIS HC A10/MF A01 CSCL 21/4

This report presents the results of prototype manufacturing, rig testing, application, and engine testing of a small advanced technology turbocharger. The turbocharger features variable turbine nozzles, ball bearings supported rotor system, self contained lube system and a broad operating range compressor. The purpose of the work was to show the potential benefits of the subject turbocharger in enhancing specific fuel consumption, emissions, and transient response of a diesel engine. The work was accomplished through laboratory testing of hardware and subsequent mathematical duty cycle simulation using the acquired data. The proposed turbocharger was manufactured and successfully run on a turbocharger test rig. Compressor maps were generated for several compressor trims with vaned and vaneless diffusers. A turbocharger was successfully run for 53 hours on a John Deere, 239 cubic inch, four cylinder, diesel engine. Fuel consumption and emissions data were obtained for

this engine as well as the 'as received' turbocharged engine and the engine with no turbochager. GRA

N80-24625# Naval Air Development Center, Warminster, Pa. Aircraft and Crew systems Technology Directorate.
SOLID FILM LUBRICATED CUTTING TOOLS Final Report
Alfeo A. Conte, Jr. and Vincent Novielli 15 Jan. 1980 51 p refs
(AD-A081541; NADC-79249-60) Avail: NTIS HC A04/MF A01 CSCL 13/9

The effect of solid film lubricants on tool life was investigated under the Navy Manufacturing Technology (MT) Program. Various solid lubricant formulations were evaluated in tapping and drilling operations on a laboratory device designed to measure the tapping efficiency of cutting fluids. The metallurgy of the workpieces studied included AISi 1020 and 4130 steels, 7075-T6 aluminum, 17-4 PH stainless steel, L-605 cobalt base alloy and Ti-6Al-4V alloy. The solid film lubricant was applied to high speed steel taps and drills and evaluated by measuring the torque developed or the number of holes the cutting tool could produce. Base line studies on uncoated cutting tools with and without the use of cutting fluid were also performed. Under the experimental conditions of this program no substantial benefit could be achieved. GRA

N80-24626# TriTec, Inc., Columbia, Md.
THE DESIGN, FABRICATION, AND TEST OF AN ELECTROFLUIDIC SERVOVALVE Final Report, Sep. 1978 - Oct. 1979
Maurice F. Funke and Lester K. Pecan Feb. 1980 58 p
(Contract DAAK51-78-C-0022; DA Proj. 1L1-62120-AH-25)
(AD-A082443; USAAVRADCOM-TR-80-D-2) Avail: NTIS HC A03/MF A01 CSCL 13/7

This report covers the design, fabrication, and testing of a dual input (hydraulic and electric) servovalve using fluidic amplifiers and positive derivative feedback. The design utilized a two-stage gain block to drive a hydraulic actuator. Electrical input signals were converted by a torque motor into mechanical motion of the first-stage flow splitter. Actuator position was fed back to a movable splitter in the second-stage amplifier. Flow to the actuator was augmented in a positive feedback sense by a spool valve whose flow was proportional to actuator velocity. Performance tests showed that the servovalve accepted and summed combinations of pressure and electrical inputs. Frequency response objectives were met without the high leakage flow penalty usually associated with this application of fluid amplifiers. GRA

N80-24627# California Univ., Livermore. Lawrence Livermore Lab.
DESIGN OF A HIGH SPEED ROTATING MECHANICAL SHUTTER
I. F. Stowers, B. T. Merritt, and C. B. McFann 6 Nov. 1979 19 p refs Presented at the 8th Symp. on Eng. Probl. of Fusion Res., San Francisco, 13-16 Nov. 1979 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-83570; CONF-791102-7) Avail: NTIS HC A02/MF A01

A high-speed rotating shutter was designed to operate in a 10 to the minus 6 power Torr vacuum at the optical focus of a laser spatial filter. The shutter is basically a wheel, with a single 3 x 10 mm slot at the perimeter, which rotates with a peripheral speed of 1 km/s. The motor to drive the rotating wheel is magnetically suspended and synchronously wound. The wheel achieves a 4 microns opening time and a timing accuracy of better than 0.2 microns. DOE

N80-24628# Argonne National Lab., Ill.
ASSESSMENT OF HIGH-HEAD TURBOMACHINERY FOR UNDERGROUND PUMPED HYDROELECTRIC STORAGE PLANTS
S. W. Tam, A. A. Frigo, and C. A. Blomquist 1979 18 p refs Presented at the 2nd Miami Intern. Conf. on Alternative Energy Sources, Coral Gables, Fla., 10-13 Dec. 1979
(Contract W-31-109-eng-38)
(CONF-791204-11) Avail: NTIS HC A02/MF A01

The costs for underground pumped hydroelectric storage (UPHS) plants equipped with advanced single and two stage reversible pumped turbines for operating heads from 500 to 1500 m are considered. The effects of machinery costs, operating heads, plant configurations and sizes are included. The results indicate that the use of advanced machinery seems to push the minimum UPHS plant cost to heads greater than 1500 m. The employment of advanced reversible pump turbines seems to be economically attractive. It is shown that pump-turbine efficiencies and the so-called charge/discharge ratio are very important design parameters for UPHS applications and the interactive effects of these parameters have been analyzed. Under certain conditions a pump-turbine option with a higher charge/discharge ratio at the expense of somewhat lower operating efficiency can be desirable. DOE

N80-24629# California Univ., Berkeley. Lawrence Berkeley Lab.
FEASIBILITY STUDY FOR DUCTILE MACHINING OF GLASS Final Report, 1 Jan. - 30 Sep. 1979
I. Finnie, J. Giovanola, A. Misra, and R. Glardon Dec. 1979 93 p refs
(Contract W-7405-eng-48)
(UCRL-15124) Avail: NTIS HC A05/MF A01

Practical ideas about the plasticity of glass, and thermal and cutting fluid effects are presented. The mechanism of chip formation and brittle failure was investigated using commercial microscope slides and especially prepared samples of lead-silicate glass and diffused silica. Results, presented in the form of SEM photographs are discussed. It is shown that lead-silicate glass is readily amenable to ductile cutting using heptanol cutting fluid. Fused silica displayed no sign of ductile behavior. DOE

N80-24630# Biomass Energy Inst., Inc., Winnipeg (Manitoba).
PROCEEDINGS FOREST AND FIELD FUELS SYMPOSIUM
1977 336 p refs Symp. held at Winnipeg, Canada, 12 Oct. 1977
(CONF-7710156) Avail: NTIS (US Sales Only) HC A15/MF A01; DOE Depository Libraries CSCL 20/3

Forest and field fuels are examined areas where RD and D [illegible] could be effective in expanding their marketability and use as substitutes for oil are identified. The present uses and immediate constraints on the wider uses of these renewable resources, compaction of field residues, and gasification and liquefaction of biomass are discussed. DOE

N80-24631# Wisconsin Univ. - Madison.
HETEROGENEOUS ENGINE IN-CYLINDER MIXING MEASUREMENTS USING A TRACER TECHNIQUE, PART 1 Final Report
S. R. Turns and G. L. Borman Mar. 1979 327 p refs
(Contract EC-77-S-02-4492)
(COO-4492-1) Avail: NTIS HC A15/MF A01

Gas-sampling characteristics of engine sampling probes were determined to assist in interpretation of engine sampling data. Of the many sources of sampling error, three were chosen for investigation: the flow disturbance associated with a probe's sink action, the flow disturbance associated with a probe's presence, and the bulk-gas sample bias caused by flame quenching at the probe's surface. Flow disturbance errors were determined by conducting experiments in a steady-flow rig, while estimates of quench-gas bias were determined principally by mathematical modeling. DOE

N80-24632# Wisconsin Univ. - Madison.
HETEROGENEOUS ENGINE IN-CYLINDER MIXING MEASUREMENTS USING A TRACER TECHNIQUE, PART 2 Final Report
A. J. Jessel and G. L. Borman Mar. 1979 131 p refs
(Contract EC-77-S-02-4492)
(COO-4492-2) Avail: NTIS HC A07/MF A01

A diagnostic technique for determining fluid motion and mixing in heterogeneous internal combustion engines involves injecting a small, discrete quantity of a gaseous tracer directly into the combustion chamber using a rapid-acting valve. Following tracer injection, a similar valve extracted a small quantity of cylinder gas which was analyzed for cycle averaged tracer concentration. For motored engine tests, an ethane/nitrogen mixture was used as the tracer with a flame ionization detector for gas analysis. Radioactive argon was employed as the tracer for fired engine

tests with a sodium iodide scintillation counter as a detector. The test engine was an open-chambered single-cylinder diesel. Data taken just prior to top center of the compression stroke indicated that the tracer puff remained largely unmixed with air over the short distance between injection and sampling valves. A swirl rate of 2.5 was calculated from motoring data. Firing results showed the tracer pulse higher in peak concentration and more compact than for the motored case. DOE

N80-24633# Technische Universitaet, Munich (West Germany). Lehrstuhl fuer Raumfahrttechnik.
CONCEPTION OF MARS ROVING VEHICLE
J. Kotnik and D. Hayn Jul. 1978 14 p refs
(TUM-LRT-KB-78/3) Avail: NTIS HC A02/MF A01

A vehicle with a minimal propulsion and fuel system is proposed to investigate a large area of the Martian surface as well as its atmosphere with one, or a few independent systems. This simple method, using the Martian winds and weather conditions for long range operation, consists of a helium filled balloon containing an automatic integrated payload. Different configurations, including combination with a Marsochod vehicle, are discussed. Feasibility in each case is argued while areas for further study, depending on the configuration chosen, are considered. Author (ESA)

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N80-24634*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONCEPTS AND TECHNIQUES FOR ULTRASONIC EVALUATION OF MATERIAL MECHANICAL PROPERTIES
Alex Vary 1980 21 p refs To be presented at the Conf. on Mech. of Nondestructive Testing, Blacksburg, Va., 10-12 Sep. 1980
(NASA-TM-81523; E-467) Avail: NTIS HC A02/MF A01 CSCL 14D

Ultrasonic methods that can be used for material strength are reviewed. Emergency technology involving advanced ultrasonic techniques and associated measurements is described. It is shown that ultrasonic NDE is particularly useful in this area because it involves mechanical elastic waves that are strongly modulated by morphological factors that govern mechanical strength and also dynamic failure modes. These aspects of ultrasonic NDE are described in conjunction with advanced approaches and theoretical concepts for signal acquisition and analysis for materials characterization. It is emphasized that the technology is in its infancy and that much effort is still required before the techniques and concepts can be transferred from laboratory to field conditions. A.R.H.

N80-24635*# Massachusetts Inst. of Tech., Cambridge.
ULTRASONIC NONDESTRUCTIVE EVALUATION OF IMPACT-DAMAGED GRAPHITE FIBER COMPOSITE
James H. Williams, Jr. and Norman R. Lampert May 1980 23 p refs
(Grant NsG-3210)
(NASA-CR-3293) Avail: NTIS HC A02/MF A01 CSCL 14D

Unidirectional Hercules AS/3501-6 graphite fiber epoxy composites were subjected to repeated controlled low-velocity drop weight impacts in the laminate direction. The degradation was ultrasonically monitored using through-thickness attenuation and a modified stress wave factor (SWF). There appears to be strong correlations between the number of drop-weight impacts, the residual tensile strength, the through-thickness attenuation, and the SWF. The results are very encouraging with respect to the NDE potential of both of these ultrasonic parameters to provide strength characterizations in virgin as well as impact-damaged fiber composite structures. R.E.S.

N80-24636# Vought Corp., Dallas, Tex.
NDI SURVEY OF COMPOSITE STRUCTURES Final Report, 5 May 1978 - 1 May 1979
Sharon A. McGovern 31 Jan. 1980 79 p refs
(Contract N62269-78-M-6391)
(AD-A081801; NADC-80032-60; Rept-2-53500/9R52131) Avail: NTIS HC A05/MF A01 CSCL 11/4

As part of the Naval Air Systems Command Maintenance Technology Program, a survey was made of DoD, NASA, NBS, Industry and the R D Community reviewing and analyzing the current status of current nondestruction inspection (NDI) technology for composites. The survey is aimed at contributing information which will assist in defining NDI requirements for the organizational, intermediate, and depot levels of maintenance. The investigation reported herein covers a survey to determine the state of NDI technology for composite materials and an analysis of the survey results in terms of maintenance requirements for naval aircraft. This review and analysis of the status of current NDI technology covers the experience of DoD, NASA, NBS, Industry, and the R D community. A range of composite materials and constructions, damage classification, repair procedures, and NDI techniques were included in the survey. Twenty-one different NDI methods were examined and ranked in terms of effectiveness. Twelve types of composited damage and five different repairs were considered during the investigation. Conclusions included definitions of the most frequently encountered types of construction, the five NDI techniques considered essential, specific technique recommendations for specified damage to specified configurations, and technique recommendations for verifying specific types of repairs. GRA

N80-24637# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
ASSESSMENT OF CRUDE OIL AND REFINED PETROLEUM PRODUCT QUALITY DURING LONG-TERM STORAGE Final Interim Report, Jun. 1978 - Dec. 1979
L. L. Stavinoha, J. N. Bowden, S. R. Westbrook, and H. N. Giles (DOE, Washington, D.C.) Dec. 1979 70 p refs
(Contracts DAAK70-78-C-0001; DAAK70-80-C-0001; EL-78-A-01-2815)
(AD-A082365; AFLRL-121) Avail: NTIS HC A04/MF A01 CSCL 15/3

It is national policy to develop a strategic petroleum reserve of up to one billion barrels of crude oil and refined petroleum products to lessen U.S. vulnerability to the effects of a severe petroleum supply interruption. A four task program was undertaken to assist in ensuring that products being considered for long term storage would remain of a quality immediately usable and to identify likely quality assurance procedures. This report summarizes the results of this work. The first task reviewed and assessed the state-of-the-art in crude and petroleum product storage. The second task investigated the effect of storage on the quality of finished products. The third task developed a DOE/SPRO computer based search capability for crude oil characterization data. The fourth and final program task consisted of an overall assessment of long term fuel storage, including recommendations for product specifications intended for storage, and test methodology for monitoring selecting product quality. GRA

N80-24638# Los Alamos Scientific Lab., N. Mex.
EVALUATION OF IN-LINE NONDESTRUCTIVE ASSAY SYSTEMS Progress Report, 1 Jul. - 30 Sep. 1979
D. F. Bowersox, N. Ensalin, S. T. Hsue, S. S. Johnson, L. G. Speir, C. A. Spirio, J. W. Tape, G. Walton, and R. B. Walton Jan. 1980 17 p refs
(Contract W-7405-eng-36)
(LA-8202-PR) Avail: NTIS HC A02/MF A01

Progress is reported in a project to design, construct, and operate nondestructive assay systems for characterizing solids and liquids containing plutonium so that automated real-time analysis of nuclear materials could be conducted in-line and at-line in processing facilities with available instruments. The two systems to be evaluated are for solids and solutions characterizations are housed in two glove boxes in the LASL Plutonium Facility. Isotopic analyses, weighing, neutron counting and optional heat treatment are planned for the solids system. Isotopic analysis, rate of flow, neutron counting, X-ray fluorescence, and absorption densitometry are designed into the liquids loop. Results will be calculated and reported by a minicomputer. DOE

N80-24639# Royal Aircraft Establishment, Farnborough (England).
FIRST REPORT OF THE MOD AEROSPACE NON-DESTRUCTIVE TESTING (NDT) SUB-COMMITTEE
D. E. W. Stone, ed. London HMSO Oct. 1979 21 p refs (RAE-TM-Struct-960; BR70938) Avail: NTIS HC A02/MF A01

Non-destructive test methods of inspecting defects in structural components of fixed and rotary wing aircraft, together with some related problems pertinent to aero-engines, are considered. Problem areas included are detection and sizing of small cracks beneath installed fasteners and in multilaminate constructions, characterization of surface breaking cracks, detection of corrosion, non-destructive measurement of residual stress, and inspection of bonded joints. Test techniques reviewed cover optical methods, ultrasonics, radiography, eddy current techniques, and the acoustic emission method. State of the art is outlined and recommendations for development based on cost effectiveness are made. Author (ESA)

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N80-24640 Utah Univ., Salt Lake City.
APPLICATIONS OF A GENERAL VARIATIONAL METHOD TO THE SOLUTIONS OF BOUNDARY VALUE PROBLEMS IN ELASTICITY Ph.D. Thesis
Danton Gutierrez-Lemini 1979 112 p
Avail: Univ. Microfilms Order No. 8009810

A comprehensive formulation of a general variational method is given in connection to boundary value problems of mathematical physics. The generality of the variational procedure is discussed, showing that it includes as special cases the established techniques in the Calculus of Variations, by Rayleigh-Ritz, Galerkin, and Trefftz. To handle problems of body force-free elastostatics, a displacement formulation of the method is also provided. A stress-function formulation of the method is subsequently derived; whereby a straightforward use of it leads to a novel and direct way of solving displacement boundary value problems in terms of stress functions. The generation of harmonic and biharmonic vectors in polar and general curvilinear coordinates is also addressed; and methods developed to cope with it. Finally, the solutions to the vector harmonic and biharmonic equations in polar coordinates are obtained; and some applications are presented to illustrate their usage. In particular, several exact solutions are arrived at for boundary value problems with traction, mixed, and dual conditions, involving multiply-and simply-connected bodies. Dissert. Abstr.

N80-24641 Brown Univ., Providence, R. I.
NUMERICAL SOLUTIONS IN DYNAMIC LINEAR ELASTIC FRACTURE MECHANICS Ph.D. Thesis
Pierre Burgers 1979 114 p
Avail: Univ. Microfilms Order No. 8006973

The dynamic propagation of a crack in an anti-plane shear deformation field was analyzed by second-order-accurate finite differences. The finite difference equations were obtained by integrating the dynamic linear elastic equations of motion along the bicharacteristic strips in four perpendicular directions and the time axis to (delta to the third power). The singularity in stresses around the crack was calculated by performing a global energy balance on a small region containing the crack tip and approximating the stresses and velocity in this region by a one term asymptotic expansion about the crack tip. Results for stresses and stress intensity factor are presented for a semi-infinite crack propagating steadily in an infinite strip, from which errors in the numerical calculations are identified. Four cases of typical non-steady crack propagation in an infinite strip following steady propagation are also considered. Dissert. Abstr.

N80-24642 Brown Univ., Providence, R. I.
SOME NOVEL PROBLEMS IN DYNAMIC CRACK PROPAGATION Ph.D. Thesis
Ibrahim Said I. Abou-Sayed 1979 107 p
Avail: Univ. Microfilms Order No. 8006965

The stress intensity factor is calculated for the problem of an infinite body containing a semi-infinite crack propagating with velocity faster than the Rayleigh wave speed but slower than the shear wave speed. The propagation of a separation zone at the cohesionless interface of two similar half-planes is considered. The stress intensity factor due to impact loading of edges of a semi-infinite crack, stationary as well as propagating, is solved. The loads are applied parallel to the crack edges and pointing in the same direction. The M-integral is derived for steadily propagating cracks and then used to calculate the energy release rate and the stress intensity factor for a crack propagating with constant velocity and subjected to a moving load. Dissert. Abstr.

N80-24643# Technische Hogeschool, Delft (Netherlands).
THE STRESS RATIO EFFECT ON FATIGUE CRACK GROWTH IN 2024-T3 ALCLAD AND THE RELATION TO CRACK CLOSURE
J. Schijve Aug. 1979 30 p refs
(M-336; ICAF-1113) Avail: NTIS HC A03/MF A01

The Elber equation for the stress ratio effect on the crack opening stress level in 2024-T3 material is unsatisfactory for negative stress ratios. A new equation is proposed and checked for crack growth data from the literature. A good agreement was obtained. Author

N80-24644# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
THE EFFECT OF AN IRREGULAR CRACK FRONT ON FATIGUE CRACK GROWTH
J. Schijve Jan. 1980 18 p refs
(Memorandum-358; ICAF-1137) Avail: NTIS HC A02/MF A01

Crack growth was initiated in 7075-T6 specimens from slits of different shapes in order to produce irregular and wavy crack fronts. Lower crack rates were found for more wavy crack fronts. Crack opening was also lower then, indicating that longer crack fronts produced lower K-values. Part of the environmental effect on crack growth is due to irregular crack fronts. The significance of fatigue fracture morphology for understanding certain influences is emphasized. Author

N80-24645# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
ENVIRONMENTAL EFFECTS OF FATIGUE FRACTURE MODE TRANSITIONS OBSERVED IN ALUMINUM ALLOYS
L. B. Vogelesang and J. Schijve Nov. 1979 27 p refs
(LR-289; ICAF-1138) Avail: NTIS HC A03/MF A01

Fatigue crack propagation tests were carried out in different environments on 7075-T6 and 2024-T3 center-cracked sheet specimens. Observations were made on the macroscopic transition from tensile mode to shear mode. The transition is suppressed by an aggressive environment, whereas it is promoted by an inert environment. As a consequence, there is no unique correlation between the state of stress and the mode of cracking. Both the state of stress and the environment have a significant effect on the mode of cracking. A simple model for the effect of environment on fatigue crack growth is presented. The implications for crack growth under corrosion fatigue conditions are discussed. Author

N80-24646# Pisa Univ. (Italy). Instituto di Aeronautica.
THE FATIGUE CRACK GROWTH UNDER VARIABLE AMPLITUDE LOADING IN BUILTUP STRUCTURES Annual Report, Sep. 1978 - Oct. 1979
A. Salvetti, G. Cavallini, and L. Lazzeri Nov. 1979 87 p refs
(Grant DA-ERO-78-G-107)
(ICAF-1139; ATR-1) Avail: NTIS HC A05/MF A01

Test were conducted on stiffened and unstiffened panels to monitor the growth of a crack both under constant and variable amplitude loads. Significant results were reached concerning: influence of the fastener flexibility and stringer-sheet friction forces on fatigue crack propagation in stiffened panels; and (2) the reliability of existing methods for predicting the growth of a crack under loading conditions in plain sheets. A reliable procedure

for evaluating the growth of a crack in built-up structure under realistic loading conditions was the developed. R.E.S.

N80-24647*# Houston Univ., Tex. Dept. of Electrical Engineering.
RESEARCH ON THE APPLICATION OF A DECOUPLING ALGORITHM FOR STRUCTURE ANALYSIS Final Report, 15 Mar. 1979 - 14 Mar. 1980
Eugene D. Denman Mar. 1980 78 p refs
(Grant NsG-1603)
(NASA-CR-163195) Avail: NTIS HC A05/MF A01 CSCL 20K

The mathematical theory for decoupling mth-order matrix differential equations is presented. It is shown that the decoupling procedure can be developed from the algebraic theory of matrix polynomials. The role of eigenprojectors and latent projectors in the decoupling process is discussed and the mathematical relationships between eigenvalues, eigenvectors, latent roots, and latent vectors are developed. It is shown that the eigenvectors of the companion form of a matrix contains the latent vectors as a subset. The spectral decomposition of a matrix and the application to differential equations is given. M.G.

N80-24648*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EIGHTH NASTRAN USER'S COLLOQUIUM
May 1980 242 p refs Colloq. held at Greenbelt, Md., 30-31 Oct. 1979
(NASA-CP-2131) Avail: NTIS HC A11/MF A01 CSCL 20K

The general application of finite element methodology and the specific application of NASTRAN to a wide variety of static and dynamic structural problems are discussed. For individual titles, see N80-24649 through N80-24661.

N80-24649*# Computer Sciences Corp., Silver Spring, Md.
ON THE CONGRUENT FEATURE IN NASTRAN
P. R. Pamidi *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 1-10 refs (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

The congruent feature, which is a capability in NASTRAN that can contribute to significant increases in computational efficiencies, is discussed. The usage of the capability and the software design characteristics affecting it are explained. The factors affecting the efficiency of the feature are pointed out. The details pertaining to the software design of the congruent feature are presented; in particular, the congruent element table is described. Serveral examples employing the congruent feature are considered and comparisons of Element Matrix Generator module computer program update times with and without this feature are presented. The results clearly demonstrate the role of the congruent feature in increasing computational efficiencies and its applicability to large-size problems. R.E.S.

N80-24650*# Gates Learjet Corp., Wichita, Kans.
DEVELOPMENT OF THE LEARJET 28/29 WING USING NASTRAN ANALYSIS
Robert R. Boroughs *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 11-32 refs (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

The structural development work performed on the Learjet 28/29 wing using NASTRAN analysis is discussed. The work included the basic sizing of primary structural members such as wing skins, wing skin splices, and spar caps, as well as the calculation of preliminary weight estimates utilizing the weight computation routine in NASTRAN. The eight spar redundancy of the Learjet wing made this task somewhat more complex than for more determinate type wing structures. Some of the problems that were encountered and the solutions and methods that were used are described. R.E.S.

N80-24651*# Goodrich (B. F.) Co., Akron, Ohio.
TENSIONING OF A BELT AROUND A DRUM USING MEMBRANE ELEMENT
C. H. S. Chen *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 33-39 refs (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

An application of the membrane element to the problem of the tensioning of a conveyer belt which wraps around a drum is presented. Two cases were investigated: (1) belt tension increase due to drum edge wear; and (2) material trapped between the drum and the belt. In both cases it was found that the increase in belt tension was due to the additional stretching of the belt resulting from the drum radius change rather than from the transverse deflection of the belt. R.E.S.

N80-24652*# Anamet Labs., Inc., Berkeley, Calif.
THERMAL STRESS ANALYSIS OF SYMMETRIC SHELLS SUBJECTED TO ASYMMETRIC THERMAL LOADS
Gordon R. Negaard *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 41-63 refs (For primary document see N80-24648 15-39)
(Contract F33615-77-C-3046)
Avail: NTIS HC A11/MF A01 CSCL 20K

The performance of the NASTRAN level 16.0 axisymmetric solid elements when subjected to both symmetric and asymmetric thermal loading was investigated. A ceramic radome was modeled using both the CTRAPRG and the CTRAPAX elements. The thermal loading applied contained severe gradients through the thickness of the shell. Both elements were found to be more sensitive to the effect of the thermal gradient than to the aspect ratio of the elements. Analysis using the CTRAPAX element predicted much higher thermal stresses than the analysis using the CTRAPRG element, prompting studies of models for which theoretical solutions could be calulated. It was found that the CTRAPRG element solutions were satisfactory, but that the CTRAPAX element was very geometry dependent. This element produced erroneous results if the geometry was allowed to vary from a rectangular cross-section. The most satisfactory solution found for this type of problem was to model a small segment of a symmetric structure with isoparametric solid elements and apply the cyclic symmetry option in NASTRAN. R.E.S.

N80-24653*# Army Armament Research and Development Command, Watervliet, N. Y. Benet Weapons Lab.
STRESS CONCENTRATIONS IN SCREW THREADS
G. Peter OHara *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 65-77 refs (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

The concept of stress concentration in screw threads was defined using the sheer transfer rate as the fundamental quantity. The stress concentration is plotted for a fixed geometry. The Heywood equation was used to generate the basic plots and NASTRAN was used to extend the analysis to the case both where flanks of an individual thread tooth are in contact. The case where a finite axial stress is superimposed is discussed. R.E.S.

N80-24654*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONDENSING LOADED POINTS FOR TRANSIENTS BY SUBSTRUCTURING
Thomas G. Butler (Butler Analysis) *In its* Eighth NASTRAN User's Colloq. May 1980 p 79-100 (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

A technique for condensing dynamic loading points is described. The method was applied to substructure transient solutions and was found to be very effective. R.E.S.

N80-24655*# Army Armament Research and Development Command, Watervliet, N. Y. Benet Weapons Lab.
IMPLEMENTATION OF A TRAPEZOIDAL RING ELEMENT IN NASTRAN FOR ELASTIC-PLASTIC ANALYSIS
P. C. T. Chen and G. P. OHara *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 101-112 refs (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

The explicit expressions for an elastic-plastic trapezoidal ring element are presented and implemented in NASTRAN computer program. The material is assumed to obey the von Mises' yield criterion, isotropic hardening rule and the Prandtl-Reuss flow relations. For the purpose of demonstration,

two elastic-plastic problems are solved and compared with previous results. The first is a plane-strain tube under uniform internal pressure and the second, a finite-length tube loaded over part of its inner surface. A very good agreement was found in both test problems. R.E.S.

N80-24656*# Planning Research Corp., Kennedy Space Center, Fla.
NORMAL MODE ANALYSIS OF THE IUS/TDRS PAYLOAD IN A PAYLOAD CANISTER/TRANSPORTER ENVIRONMENT
Karl A. Meyer *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 113-129 refs (For primary document see N80-24648 15-39)
(Contract NAS10-8525)
Avail: NTIS HC A11/MF A01 CSCL 20K

Special modeling techniques were developed to simulate an accurate mathematical model of the transporter/canister/payload system during ground transport of the Inertial Upper Stage/Tracking and Data Relay Satellite (IUS/TDRS) payload. The three finite element models - the transporter, the canister, and the IUS/TDRS payload - were merged into one model and used along with the NASTRAN normal mode analysis. Deficiencies were found in the NASTRAN program that make a total analysis using modal transient response impractical. It was also discovered that inaccuracies may exist for NASTRAN rigid body modes on large models when Given's method for eigenvalue extraction is employed. The deficiencies as well as recommendations for improving the NASTRAN program are discussed. R.E.S.

N80-24657*# Naval Underwater Systems Center, New London, Conn.
STEADY STATE SOLUTIONS TO DYNAMICALLY LOADED PERIODIC STRUCTURES
Anthony J. Kalinowski *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 131-164 refs (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

The general problem of solving for the steady state (time domain) dynamic response (i.e., NASTRAN rigid format-8) of a general elastic periodic structure subject to a phase difference loading of the type encountered in traveling wave propagation problems was studied. Two types of structural configurations were considered; in the first type, the structure has a repeating pattern over a span that is long enough to be considered, for all practical purposes, as infinite; in the second type, the structure has structural rotational symmetry in the circumferential direction. The theory and a corresponding set of DMAP instructions which permits the NASTRAN user to automatically alter the rigid format-8 sequence to solve the intended class of problems are presented. Final results are recovered as with any ordinary rigid format-8 solution, except that the results are only printed for the typical periodic segment of the structure. A simple demonstration problem having a known exact solution is used to illustrate the implementation of the procedure. R.E.S.

N80-24658*# Northrop Corp., Los Angeles, Calif.
APPLICATIONS OF NASTRAN IN GUST RESPONSE ANALYSIS AT NORTHROP
Ashok K. Singh *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 165-188 refs (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

A comprehensive gust response analysis was performed on a complete model of an airplane using the NASTRAN aeroelastic package. The analysis investigated random response to atmospheric turbulence and transient response to a discrete gust, including control system dynamics in both cases. It is shown that NASTRAN is an effective tool for aeroelastic analysis and active control system design. R.E.S.

N80-24659*# Lincoln Lab., Mass. Inst. of Tech., Lexington.
IMPLEMENTATION OF NASTRAN ON THE IBM/370 CMS OPERATING SYSTEM
Stephen S. Britten and Betsy Schumacker *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 189-203 refs Sponsored in part by the Air Force (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

The NASA Structural Analysis (NASTRAN) computer program is operational on the IBM 360/370 series computers. While execution of NASTRAN has been described and implemented under the virtual storage operating systems of the IBM 370 models, the IBM 370/168 computer can also operate in a time-sharing mode under the virtual machine operating system using the Conversational Monitor System (CMS) subset. The changes required to make NASTRAN operational under the CMS operating system are described. R.E.S.

N80-24660*# Sikorsky Aircraft, Stratford, Conn.
IFEMS, AN INTERACTIVE FINITE ELEMENT MODELING SYSTEM USING A CAD/CAM SYSTEM
Spencer McKellip, Todd Schuman, and Spencer Lauer *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 205-221 (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

A method of coupling a CAD/CAM system with a general purpose finite element mesh generator is described. The three computer programs which make up the interactive finite element graphics system are discussed. R.E.S.

N80-24661*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF A DATA BASE MANAGEMENT SYSTEM TO A FINITE ELEMENT MODEL
James L. Rogers, Jr. *In* NASA. Goddard Space Flight Center Eighth NASTRAN User's Colloq. May 1980 p 223-234 (For primary document see N80-24648 15-39)
Avail: NTIS HC A11/MF A01 CSCL 20K

In today's software market, much effort is being expended on the development of data base management systems (DBMS). Most commercially available DBMS were designed for business use. However, the need for such systems within the engineering and scientific communities is becoming apparent. A potential DBMS application that appears attractive is the handling of data for finite element engineering models. The applications of a commercially available, business-oriented DBMS to a structural engineering, finite element model is explored. The model, DBMS, an approach to using the DBMS, advantages and disadvantages are described. Plans for research on a scientific and engineering DBMS are discussed. R.E.S.

N80-24662# Naval Ship Research and Development Center, Bethesda, Md. Computation Mathematics/Logistics Dept.
FINITE ELEMENT ANALYSIS OF PIPE ELBOWS Final Report, Oct. 1978 - Sep. 1979
Melvyn S. Marcus and Gordon C. Everstine Feb. 1980 95 p refs
(AD-A081077; DTNSRDC/CMLD-79/15) Avail: NTIS HC A05/MF A01 CSCL 13/11

NASTRAN analyses were performed with three different finite element models on a 90 degree pipe elbow to determine principal stresses due to internal pressure, inplane bending, out-of-plane bending, and torsion moment loadings. Comparison with stresses experimentally obtained under the four loading conditions demonstrates the adequacy of a finite element model with ideal geometry assumptions and an economical mesh spacing. Implementation of the NASTRAN modeling is described in detail. Deck set-ups for a sequence of computer runs to automatically generate NASTRAN input data, execute NASTRAN, and postprocess NASTRAN output are included. A sample NASTRAN data input file is also listed. GRA

N80-24663# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
EFFECTS OF MATERIAL BEHAVIOR ON THE RESPONSE OF RAPIDLY HEATED STRUCTURES Technical Report, Feb. 1978 - Dec. 1979
S. F. Stone Jan. 1980 112 p refs
(Contract N00014-75-C-0646; NR Proj. 064-566)
(AD-A082148; MDC-G8432) Avail: NTIS HC A06/MF A01 CSCL 20/11

An investigation into the theoretical requirements for short time elevated temperature material property data to be used in a structural analysis to predict the response and failure of

structures subject to the combined effects of mechanical and thermal loads due to rapid heating was undertaken. An assessment of the ability of the MARC and ANSYS finite-element computer codes to perform the required analysis was made. An evaluation of the suitability of existing mechanical material property data for 6061-T6 aluminum was made in light of the theoretical requirements. Uniaxial simulation experiments were performed in which load and temperature were varied as a function of time in order to simulate the loading and unloading behavior that occurs in locally heated structures. Basic uniaxial material property tests were conducted. These data were used to obtain time independent ('zero' time) temperature dependent elastic-plastic stress/strain curves and time dependent creep curves. A one dimensional direct integration code 'CREEPARHS' was written to perform the required analysis and to check the results from the finite elements codes. Analysis using the newly generated material property data and currently available 10 second isochronous and handbook data was performed. GRA

N80-24664# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.

DUCTILE FRACTURE UNDER MULTIAXIAL STRESS STATES BETWEEN PAIRS OF HOLES

R. J. Bourcier and D. A. Koss Nov. 1979 21 p refs

(Contract N00014-76-C-0037)

(AD-A081976; TR-11) Avail: NTIS HC A02/MF A01 CSCL 20/11

As a means of examining ductile fracture under multiaxial stress and strain states, the deformation and fracture between pairs of holes has been studied in a 7075 Al alloy. The test technique, which is unique, utilizes tensile samples each with a pair of holes through the thickness. The holes are sufficiently close (two hole diameters apart) so as to concentrate slip between them, and the local states of stress and strain can be controlled by the orientation of the holes to the stress axis. The influence of hole orientation on the strain at fracture has been determined in the 7075 Al alloy in the T6 as well as TO tempers. Fracture occurs by flow localization between the holes and very little hole growth occurs, especially in the T6 condition. Fractography indicates a transition in fracture appearance with hole orientation with dimpled fracture predominating, but the degree of shear fracture increases as the pair of holes become more inclined to the stress axis. A modification of the Bridgeman analysis is used as a description of the approximate state of stress between the holes as a function of the hole orientation. The results indicated that the criterion for ductile fracture depends on both the state of stress and the strain state, but the functional dependence could not be determined. The results are also discussed as a crude model for void coalescence in ductile fracture. GRA

N80-24665# California Univ., Los Angeles. Dept. of Materials.

MAGNETOMECHANICAL ACOUSTIC EMISSION FOR RESIDUAL STRESS AND PRIOR STRAIN DETERMINATION

Kanju Ono and M. Shibata Oct. 1979 36 p refs Presented at the Intern. Conf. on Acoustic Emission, Anaheim, Calif., 10-13 Sep. 1979

(Contract N00014-75-C-0419)

(AD-A081912; TR-79-04) Avail: NTIS HC A03/MF A01 CSCL 20/1

This study evaluated magnetomechanical acoustic emission (MAE) in iron, nickel, steels and an iron-nickel alloy. The intensity of MAE increased with an increasing level of magnetization at 60 Hz and was also dependent on chemical composition, microstructure, applied stress, and prior cold work. Nickel was the highest emitter and the iron-31% nickel alloy was the lowest. Martensitic transformation and cold-working reduced MAE. Applied stress also suppressed MAE, although some enhancements were observed in nickel and A533B steel. A model based on displacement step generation is proposed. The displacement is a consequence of domain boundary motion that alters magnetostrictive strain. The model satisfactorily explains a variety of experimental observations at least qualitatively. However, independent experiments will be needed to confirm some of the assumptions. Results presented amply demonstrate that MAE provides the basis for a new class of nondestructive testing of residual stress and other material parameters of practical interest. GRA

N80-24666# Cincinnati Univ., Ohio. Dept. of Engineering Science.

MULTI-BODY DYNAMIC INCLUDING THE EFFECTS OF FLEXIBILITY AND COMPLIANCE Technical Report, 30 Sep. 1978 - 29 Feb. 1980

Ronald L. Huston 1 Apr. 1980 61 p refs

(Contract N00014-76-C-0139)

(AD-A082762; UC-ES-040180-8-ONR) Avail: NTIS HC A04/MF A01 CSCL 20/11

New and recently developed concepts and ideas useful in obtaining efficient computer algorithms for solving the equations of motion of multi-body mechanical systems with flexible links are presented and discussed. These ideas include the use of Euler parameters, Lagrange's form of d'Alembert's principle, generalized speeds, quasi-coordinates, relative coordinates, structural analysis techniques and body connection arrays. The mechanical systems considered are linked bodies forming a tree structure, but with no closed loops permitted. An explicit formulation of the equations of motion is presented. GRA

N80-24667# Naval Surface Weapons Center, White Oak, Md.

DYNAMIC BUCKLING OF CYLINDRICAL SHELLS: A LITERATURE SURVEY Final Report

David B. Grenier 23 Oct. 1979 83 p refs

(SR0230300)

(AD-A082049; NSWC/TR-79-447) Avail: NTIS HC A05/MF A01 CSCL 20/11

A literature survey was conducted in order to ascertain the current theoretical methods available for predicting dynamic buckling behavior of cylindrical shells. Existing theories which give consideration to advanced shell wall geometries and materials are examined. Emphasis is placed on theories which lend themselves either to a closed form solution or to an iterative solution which does not require finite difference or finite element modeling. The task of developing such theories appears to be so overwhelming that few investigators stepped further than the bounds of a simple monocoque shell subjected to end or side-pulse loading. A brief summary and critique of each significant article is included. Further work is directed in the modification of existing programs to create general dynamic shell design criteria. GRA

N80-24668# Naval Ship Research and Development Center, Bethesda, Md. Computation, Mathematics, and Logistics Dept.

CONSTRAINED OPTIMIZATION OF HOLE SHAPES IN PLATE STRUCTURES Interim Report, Jun. 1979 - Jan. 1980

S. K. Dhir Feb. 1980 22 p refs

(SR0140301)

(AD-A082518; DTNSRDC/CMLD-80/02) Avail: NTIS HC A02/MF A01 CSCL 20/11

An analytical/numerical procedure has been developed which yields the optimum geometry for a constrained hole shape in a large plate under prescribed boundary stresses at infinity. The optimality criterion is based on the minimization of a certain stress integral taken around the hole boundary. Muskhelishvili's method is used to first obtain the symbolic stress expressions for a given mapping function with unknown coefficients. These stress expressions are then squared and integrated around the hole boundary to obtain the stress integral. The squaring prevents any cancellation of compressive and tensile stresses during the integration process and thus produces a more meaningful integral. A sample problem is worked out in detail to demonstrate this procedure. The optimum shape of a square-like (double barrel shape) hole with rounded corners was determined by restricting the mapping function to only one specific unknown coefficient. Modification of this shape by introduction of an additional term is also discussed. Numerical stress concentration values for this case are compared with those from other sources. GRA

N80-24669# Naval Ship Research and Development Center, Bethesda, Md.

PIEZOELECTRIC FINITE ELEMENTS FOR NASTRAN Final Report, Jun. - Sep. 1979

Robert R. Lipman and Myles M. Hurwitz Apr. 1980 34 p refs

(RR0310301)
(AD-A082965; DTNSRDC-80/045) Avail: NTIS HC A03/MF A01 CSCL 17/1

The NASTRAN structural analysis program has been modified so that its TRAPAX and TRIAAX finite elements may handle piezoelectric material properties. These elements are solid, axisymmetric ring elements capable of handling nonaxisymmetric loads. The natural frequencies of a piezoelectric hollow cylinder and a piezoelectric disk with electroded surfaces were computed with this modified version of NASTRAN and were found to be in excellent agreement with experimental and other numerical results. GRA

N80-24670# California Univ., Livermore. Lawrence Livermore Lab.

STRESS-RUPTURE LIFETIMES OF ORGANIC FIBER-EPOXY STRANDS AND PRESSURE VESSELS

H. T. Hahn, I. L. Chiu, and T. L. Gates 21 Aug. 1979 25 p refs Presented at the 35th Ann. Conf. of the SPI Reinforced Plastics/Composites Inst., New Orleans, 4-8 Feb. 1980
(Contract W-7405-eng-48)
(UCRL-82862; CONF-800203-1) Avail: NTIS HC A02/MF A01

In an effort to determine the long-term behavior of filament-wound pressure vessels, Kevlar 49 epoxy strands were studied in stress-rupture for more than a year at five different stress levels. At each stress level, approximately one-hundred strands were hung in a room maintained at 22 C to 24 C and below 20% relative humidity. Failure times were automatically recorded by a data acquistion system. The shape parameter increased with decreasing stress level. Less scatter and increasing failure rates were observed at lower stresses. There was no sign of an endurance limit down to 68% UTS (ultimate tensile strength). At 50% UTS no failure had yet occured after 9000 h. The strand data were compared with data on lifetimes of pressure vessels wound with the same fiber and epoxy. The strands had slightly longer characteristic lifetimes, except at 86% UTS, and slightly less scatter, except at 68% UTS. DOE

N80-24671# Royal Aircraft Establishment, Farnborough (England).

DATA GENERATION COMPUTER PROGRAMS FOR SHELL FINITE ELEMENTS

Susan M. Ford London HMSO Jul. 1979 55 p refs
(RAE-TM-Struct-954; BR70226) Avail: NTIS HC A04/MF A01

A series of computer programs written in ICL 1900 series FORTRAN is presented to generate data for the finite element analysis of shells, with particular reference to spherical surfaces. The programs are appropriate either to a finite element program containing the RAE SEMILOOF thin shell element, of for a NASTRAN package containing the TRIA 3 and QUAD 4 facet shell elements. The two types of program are described. The programs generate data specifically for meshes on the surface of a sphere. They are used to generate all the data for the hemispherical cap and patch test problems considered by Morley and Norris. Results are shown. Author (ESA)

N80-24672# Royal Aircraft Establishment, Farnborough (England).

OPENING-MODE STRESS INTENSITY FACTORS FOR TWO UNEQUAL CRACKS AT A HOLE

D. P. Rooke (Old Dominion Univ.) and J. Tweed London HMSO Aug. 1979 31 p refs
(RAE-TR-79105; RAE-Mat-386; BR71448) Avail: NTIS HC A03/MF A01

An integral-transform method is used to solve the elastic problem of two collinear cracks at the edge of a hole in a sheet. Both uniform loadings on the sheet remote from the crack and loadings on the perimeter of the hole are considered. Since in all cases the loadings are symmetrical about the crackline, only the opening-mode stress intensity factors are nonzero; these factors are calculated. An approximation procedure is examined for obtaining stress intensity factors for two cracks at a hole from that for one crack. Results show that the errors in the approximation used are small. The possibility of extending this approximation technique to other configurations for which only single crack results are known is considered. Author (ESA)

N80-24673# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Numerical Analysis and Computing Science.

ANALYSIS OF SOME DIFFICULTIES ENCOUNTERED IN THE SIMULATION OF MECHANICAL SYSTEMS WITH CONSTRAINTS

Per Loetstedt 1979 76 p refs Sponsored in part by Swedish Inst. of Appl. Math.
(TRITA-NA-7914) Avail: NTIS HC A05/MF A01

Mathematical properties of mechanical systems of rigid bodies with constraints are investigated. In particular, properties of interest for the digital simulation of such systems are studied. Much attention is paid to normal and friction forces in planar systems. The main mathematical tool is the theory of linear complementarity problems. Problems where the constraints give rise to normal forces only are found to be much simpler than those with Coulomb friction. For systems exposed to friction, solutions may fail to exist and if they do exist, they need not be unique. The related question of how to compute impulses, e.g., after a collision, is treated briefly. Author (ESA)

N80-24674# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

FINITE ELEMENT ANALYSIS OF CONCRETE CRACKING

J. H. Argyris, G. Faust, and K. J. Willam Jan. 1979 28 p refs Presented at IASS Symp., Darmstadt, West Germany, 3-7 Jul. 1978
(Contract BMFT-RK-SBB4)
(ISD-254) Avail: NTIS HC A03/MF A01

Critical factors which determine the predictive quality of the finite element analysis of tensile concrete cracking are identified. In particular, two popular methods are explored. These are the smeared crack approach (strength model) and the discrete crack approach (fracture mechanics model). The limitations of these widely accepted strategies are illustrated using the example of a thick walled concrete ring. Extensive strength and deformation data results are obtained. Author (ESA)

N80-24675# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

EULERIAN AND LAGRANGIAN TECHNIQUES FOR ELASTIC AND INELASTIC LARGE DEFORMATION PROCESSES

J. H. Argyris, J. S. Doltsinis, W. C. Knudson, J. Szimmat, H. Wuestenberg, and K. J. Willam May 1979 63 p refs Presented at TICOM 2, Austin, Tex., 26-29 Mar. 1979
(ISD-256) Avail: NTIS HC A04/MF A01

Two fundamentally different methods for solving elastic and inelastic large deformation problems are examined. These are the viscous flow approach with a Eulerian description of the velocity field using a finite element mesh fixed in space, and the solid mechanics approach with a Lagrangian description of the displacement field using an update material mesh for tracing the motion of each particle. The two techniques are assessed and evaluated for analysis of combined elastic and inelastic material processes of the rigid plastic and elasto-plastic type. Both formulations are illustrated on two forming problems: the extrusion of an aluminum billet through a curved nozzle and the heat forming of a steel bolt. Results are reported and compared. Author (ESA)

N80-24676# Royal Aircraft Establishment, Farnborough (England).

METHODS FOR DETERMINING UNDAMPED NORMAL MODES AND TRANSFER FUNCTIONS FROM RECEPTANCE MEASUREMENTS

D. R. Gaukroger and J. C. Copley London HMSO Jun. 1979 35 p refs
(RAE-TR-79071; RAE-Struct-BF/B/0793; BR70158) Avail: NTIS HC A03/MF A01

Possible approaches to the determination of the dynamic characteristics of a system from receptance measurements are considered. The particular characteristics of interest are transfer functions for which no direct measurements are available and their undamped normal modes. A simple example using calculated receptances which are degraded with random errors indicates the degree of accuracy which might be expected from various methods of analysis. Author (ESA)

N80-24677# Texas Univ. at Austin. Structures Research Lab.
SHEAR BEHAVIOR OF REINFORCED CONCRETE MEMBERS UNDER BIDIRECTIONAL REVERSED LATERAL LOADING Ph.D. Thesis
K. Maruyama and James O. Jirsa Aug. 1979 133 p refs
(Grant NSF ENV-77-20816)
(PB80-140395; CESRL-79-1; NSF/RA-79-270) Avail: NTIS HC A07/MF A01 CSCL 13M

The influence of lateral load of deformation history on shear behavior was examined. Each load path of load sequence was imposed on the specimens using a specially fabricated servo-controlled loading system which applied lateral translations perpendicular to the longitudinal axis of the specimen. Rotation of the ends of the specimens was controlled to simulate a column between stiff floors. The influence on load and deformation history was examined by comparing performance in terms of shear strength deterioration stiffness reduction, strain distribution in transverse reinforcement, and crack patterns. A conceptual model was developed for analyzing the shear behavior of members under multi directional loading. GRA

42 GEOSCIENCES (GENERAL)

N80-24678*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR-TERRESTRIAL PREDICTIONS PROCEEDINGS. VOLUME 2: WORKING GROUP REPORTS AND REVIEWS
Richard F. Donnelly, ed. (NOAA, Boulder, Colo.) Dec. 1979 744 p refs Workshop held in Boulder, Colo., 23-27 Apr. 1979; sponsored by NOAA Sponsored in part by AFGL, AFOSR, DOE, NSF and NOAA 4 Vol.
(NASA-TM-81061) Avail: NTIS HC A99/MF A01 CSCL 04A

Accurate models are needed to support research in the following areas: spacecraft charging, radiation dosage, transionospheric radio propagation, long and short term solar activity, magnetospheric disturbances, ionospheric interactions, solar weather/climate effects, and geomagnetic applications such as electric power transmission and oil and gas pipeline problems. For individual titles, see N80-24679 through N80-24726.

N80-24679*# Aerospace Corp., Los Angeles, Calif.
USER REQUIREMENTS OF SOLAR-TERRESTRIAL PREDICTIONS FOR SPACECRAFT APPLICATIONS c12
A. L. Vampola, R. Altrock, W. Atwell, R. C. Backstrom, H. B. Garrett, David R. Hickman, R. G. Johnson, N. H. Pereyaslova, D. Robbins, and J. Slowey *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 1-20 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 22A

Areas which are influenced by solar-terrestrial coupling effects and which are internal to the Earth's magnetosphere are of interest to mission planners, spacecraft hardware designers, and those engaged in the operation of already orbiting manned or unmanned spacecraft. Accurate models are needed to predict energetic particle flux density, interactions between low energy (10 eV to 100 eV) near-Earth plasma and space systems, and neutral atmospheres. Parameters required for each of these areas are discussed. A.R.H.

N80-24680*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MODELING THE EARTH'S RADIATION BELTS. A REVIEW OF QUANTITATIVE DATA BASED ELECTRON AND PROTON MODELS c46
J. I. Vette, M. J. Teague, D. M. Sawyer, and K. W. Chan *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 21-35 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

The evolution of quantitative models of the trapped radiation belts is traced to show how the knowledge of the various features has developed, or been clarified, by performing the required analysis and synthesis. The Starfish electron injection introduced problems in the time behavior of the inner zone, but this residue decayed away, and a good model of this depletion now exists. The outer zone electrons were handled statistically by a log normal distribution such that above 5 Earth radii there are no long term changes over the solar cycle. The transition region between the two zones presents the most difficulty, therefore the behavior of individual substorms as well as long term changes must be studied. The latest corrections to the electron environment based on new data are outlined. The proton models have evolved to the point where the solar cycle effect at low altitudes is included. Trends for new models are discussed; the feasibility of predicting substorm injections and solar wind high-speed streams make the modeling of individual events a topical activity. Author

N80-24681*# Air Force Geophysics Lab., Hanscom AFB, Mass.
LOW ENERGY MAGNETOSPHERIC PLASMA INTERACTIONS WITH SPACE SYSTEMS: THE ROLE OF PREDICTIONS c46
H. B. Garrett *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 36-70 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

The present status of low energy magnetospheric plasma interactions with space systems is reviewed. The role of predictions in meeting user needs in assessing the impact of such interactions is described. In light of the perceived needs of the user community and of the current status of modeling and prediction efforts, it is suggested that for most user needs more detailed statistical models of the low energy environment are required. In order to meet current prediction requirements, real-time in situ measurements are proposed as a near-term solution. Author

N80-24682*# Aerospace Corp., Los Angeles, Calif. Space Sciences Lab.
PREDICTABILITY OF UPPER-ATMOSPHERIC DENSITY AND COMPOSITION c46
Joe M. Straus and David R. Hickman *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 71-88 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

Empirical models of upper-atmospheric density and composition are employed in a number of areas, ranging from basic research in atmospheric and ionospheric physics to practical applications in satellite ephemeris prediction. Such models are based on various kinds of data sets and have varying levels of complexity, strengths, and weaknesses. The characteristics of several of the widely used models are described and studies in which the predictions of these models were compared with observational data are reviewed. The relative advantages and limitations of the models in current use are discussed as well as ways in which the models might be improved. A.R.H.

N80-24683*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR-INDUCED VARIATIONS OF ENVIRONMENT AFFECTING MANNED SPACE FLIGHT AND SPACECRAFT OPERATIONS c12
William G. Johnson, Thomas A. Parnell, and William W. Vaughan *In its* Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 89-103 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 22A

Estimates of short and long term solar activity are required for calculating variations in the environment with regard to spacecraft charging, radiation effects, and orbital lifetime. Correlations appear to exist between the time of solar activity and the time of operational anomalies due to electrical discharges when the dielectric surfaces of geosynchronous spacecraft are charged by interaction with the ambient plasma to levels above breakdown voltage. An ability to predict the solar induced variation variability of the plasmas could permit refinement of design criteria. The influence of the radiation on spacecraft materials, systems, and manned operations is summarized. Solar radition effects on the orbital altitude atmospheric density environment and spacecraft lifetimes are also considered. A.R.H.

N80-24684*# Air Force Geophysics Lab., Hanscom AFB, Mass. Space Physics Div.

PREDICTION OF SPACECRAFT POTENTIALS AT GEOSYNCHRONOUS ORBIT **c18**

H. B. Garrett, A. G. Rubin, and C. P. Pike *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 104-118 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 22B

Two relatively straightforward techniques are outlined for determining spacecraft potentials in the limit of a 'thick sheath' surrounding the spacecraft. A statistical model of the various features of the geosynchronous environment based on ATS-5 and ATS-6 data and an analytic model capable of detailed simulation of the low energy geosynchronous environment are also discussed. The results from these two environmental models are then combined with the charging models in order to provide estimates of the relationships between the geomagnetic index and spacecraft potential. The results are compared with actual potential measurements from ATS-5 and ATS-6. Author

N80-24685*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE TERPESTRIAL RADIATION ENVIRONMENT AND EVA'S: PREDICTION REQUIREMENTS, MODEL IMPROVEMENTS, AND WARNING SYSTEMS **c54**

E. G. Stassinopoulos *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 119-120 (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 05H

The total medical-biological impact of the Earth's space radiation environment on humans is a function of combined EVA and non-EVA exposure. In either case, the correct assessment of the eventual health risk to crew members is crucial to the success and viability of a project or mission. Aside from the medical-biological aspect itself, the validity of any assessment depends entirely on the existence of good and reliable models providing the high quality data that is needed for such evaluations, which should contain time histories of storm and substorm events, their intensities, their frequency of occurrence, and their duration. Prediction requirements, advantageous and desirable model developments and improvements, and systems that need to be designed and tested, which would alert space crews and maintenance personnel about impending radiation danger are outlined. A.R.H.

N80-24686*# Rockwell International Corp., Houston, Tex.

DOSIMETRY IN THE MANNED SPACE PROGRAM **c46**

William Atwell *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 121-132 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 03B

Dosimetric results of the various U.S. manned spaceflight programs are presented along with a description of the instrumentation, trapped radiation environments, and spacecraft shielding models. Analytical dose calculations are included and composed with actual measurements. Future requirements of the solar-terrestrial data user who will support manned spaceflight operations during the space shuttle era are outlined. A.R.H.

N80-24687*# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.

MAGNETIC STORM EFFECTS IN ELECTRIC POWER SYSTEMS AND PREDICTION NEEDS **c33**

Vernon D. Albertson and John G. Kappenman (Minnesota Power and Light Co.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 137-148 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 09C

Geomagnetic field fluctuations produce spurious currents in electric power systems. These currents enter and exit through points remote from each other. The fundamental period of these currents is on the order of several minutes which is quasi-dc compared to the normal 60 Hz or 50 Hz power system frequency. Nearly all of the power systems problems caused by the geomagnetically induced currents result from the half-cycle saturation of power transformers due to simultaneous ac and dc excitation. The effects produced in power systems are presented, current research activity is discussed, and magnetic storm prediction needs of the power industry are listed. Author

N80-24688*# British Columbia Univ., Vancouver. Dept. of Geophysics and Astronomy.

THE PROBLEM OF SOLAR INDUCED CURRENTS **c33**

D. H. Boteler *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 149-161 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 09C

The production of surface electric fields by geomagnetic variations is discussed with reference to magnetotelluric theory; and evidence is presented to show that the severity of solar-induced currents (SIC) at Cornerbrook, Newfoundland is due to channeling of currents induced in the sea through a region adjacent to the power line. An 'isolated loop' approximation is proposed for calculating the quasi-dc currents produced in the power system by the surface electric fields. Identification of the processes causing the geomagnetic perturbations responsible for SIC would be aided by investigation of the local time dependence of SIC occurrence. Such knowledge could potentially be used to provide several hours warning of SIC. A.R.H.

N80-24689*# Manitoba Univ., Winnipeg. Dept. of Electrical Engineering.

PREDICTION OF SOLAR INDUCED CURRENTS AND EFFECTS ON POWER TRANSMISSION SYSTEMS IN CENTRAL CANADA **c33**

W. R. Goddard and W.-M. Boerner (Illinois Univ. at Chicago Circle) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 162-171 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 09C

The auroral-electrojet zone covers three quarters of Manitoba and consequently, solar storms strongly affect transmission lines. Harmonics are generated at transformers due to the saturation of their cores by induced currents, and the level of harmonics produced may cause malfunction of control relays, and yield unacceptable distortions in normal ac waveforms. The expected effects of long ac transmission systems were studied with emphasis on a 500 kv line to be built from Winnipeg to Minneapolis-St. Paul. Spectral analysis of induced current records from Manitoba Hydro's LaVerendrye station and magnetograms from IMS stations in Manitoba were used along with results of Campbell's work on the Alaskan pipeline induction problem (1978) in order to predict periodic and surge currents. It is concluded that the surge currents will produce significant levels of harmonics and corresponding operating problems during magnetic storms. A.R.H.

N80-24690*# British Columbia Univ., Vancouver. Dept. of Geophysics and Astronomy.

HARMONICS OF 60 Hz IN POWER SYSTEMS CAUSED BY GEOMAGNETIC DISTURBANCES **c33**

K. Hayashi, T. Oguti, T. Watanabe, K. Tsuruda, S. Kokubun, and R. E. Horita (Victoria Univ., British Columbia) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 172-181 refs Prepared in cooperation with Tokyo Univ., Japan (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 09C

Simultaneous VLF/ULF observations carried out near Winnipeg, Manitoba show that geomagnetic disturbances control the behavior of harmonics of 60 Hz man-made electric power. The harmonics of 60 Hz detected by the VLF receiver are at multiples of 180 Hz, indicating that they originated from a 3 phase ac power system. Under geomagnetically quiet conditions, only odd harmonics of 70 Hz were detected. In disturbed conditions, both odd and even harmonics were excited. The strength of each harmonic changed concurrently with geomagnetic pulsation (ULF) activity. These findings seem to indicate that a portion of telluric currents shunted into the power line system through the neutrals of the Y-connected transformers give rise to a dc bias to the transformer core materials and that it distorts their hysteresis loops, activating harmonics of 60 Hz power. A mathematical proof is given that a hysteresis loop having a point of symmetry generates odd harmonics only, whereas loops lacking in point-symmetry generally give rise to both odd and even harmonics. A general formula was obtained to calculate the

strength of each harmonic based on the shape of the hysteresis loop. A.R.H.

N80-24691*# Geological Survey, Denver, Colo.
INDUCED ELECTRIC CURRENTS IN THE ALASKA OIL PIPELINE MEASURED BY GRADIENT, FLUXGATE, AND SQUID MAGNETOMETERS **c33**
Wallace H. Campbell and James E. Zimmerman (NBS, Boulder, Colo.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 182-192 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 09C

The field gradient method for observing the electric currents in the Alaska pipeline provided consistent values for both the fluxgate and SQUID method of observation. These currents were linearly related to the regularly measured electric and magnetic field changes. Determinations of pipeline current were consistent with values obtained by a direct connection, current shunt technique at a pipeline site about 9.6 km away. The gradient method has the distinct advantage of portability and buried-pipe capability. Field gradients due to the pipe magnetization, geological features, or ionospheric source currents do not seem to contribute a measurable error to such pipe current determination. The SQUID gradiometer is inherently sensitive enough to detect very small currents in a linear conductor at 10 meters, or conversely, to detect small currents of one amphere or more at relatively great distances. It is fairly straightforward to achieve imbalance less than one part in ten thousand, and with extreme care, one part in one million or better. A.R.H.

N80-24692*# Space Environment Services Center, Boulder, Colo.
VERY LARGE GEOMAGNETIC DISTURBANCE DURING SUNSPOT CYCLE 21: A PREDICTION **c92**
H. H. Sargent, III *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 193-197 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

Evidence is presented which suggests that very large geomagnetic disturbances (350 gammas or greater at an invariant magnetic latitude of 50 degrees) occur once or twice per sunspot cycle, on the average. There is also some tendency for these disturbances to group in large odd numbered sunspot cycles similar to the current cycle, cycle 21. No such disturbance was noted during the past cycle although a series of major solar flares was observed in August 1972. At least one very large geomagnetic disturbance is expected during the current cycle; a prediction with perhaps serious consequences for electric power companies. Author

N80-24693*# Los Alamos Scientific Lab., N. Mex.
POTENTIAL PREDICTION NEEDS IN SUPPORT OF ENERGY SYSTEMS **c44**
Richard L. Blake *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 198-202 ref Sponsored in part by DOE (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 10B

The relationship between emerging energy systems and the natural environment is discussed, including selected examples to show that energy systems are tied to global solar terrestrial processess. The interdependence of resources, technology, and environmental impact is considered in terms of needed geophysical, atmospheric, and solar terrestrial data inputs. The need for long term basic research on the solar terrestrial system is emphasized. J.M.S.

N80-24694*# National Physical Lab., New Delhi (India). Radio Science Div.
IONOSPHERE-REFLECTED PROPAGATION **c32**
B. M. Reddy *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 203-216 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 17B

The predictability of those ionospheric parameters relevant to ionosphere-reflected communications is considered along with their optimum utilization. Several excellent original articles and review papers which have been published from time to time dealing with the long term and short term forecasting of ionospheric parameters, radio systems, and modelling needs for ionospheric communications, are covered. J.M.S.

N80-24695*# Air Force Geophysics Lab., Hanscom AFB, Mass.
TRANSIONOSPHERIC PROPAGATION PREDICTIONS **c32**
J. A. Klobucher, Santimay Basu (Emmanuel Coll.), Sunanda Basu (Emmanuel Coll.), P. A. Bernhardt (Stanford Univ.), K. Davies (NOAA, Boulder, Colo.), D. E. Donatelli (Regis Coll.), E. J. Fremouw (Phys. Dyn., Inc., Bellevue, Wash.), J. M. Goodman (NRL, Washington, D.C.), G. K. Hartmann (Max-Planck Inst. fuer Aeronomie, Kattenburg-Lindau, West Germany), R. Leitinger (Graz Univ.) et al *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 217-245 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 20N

The current status and future prospects of the capability to make transionospheric propagation predictions are addressed, highlighting the effects of the ionized media, which dominate for frequencies below 1 to 3 GHz, depending upon the state of the ionosphere and the elevation angle through the Earth-space path. The primary concerns are the predictions of time delay of signal modulation (group path delay) and of radio wave scintillation. Progress in these areas is strongly tied to knowledge of variable structures in the ionosphere ranging from the large scale (thousands of kilometers in horizontal extent) to the fine scale (kilometer size). Ionospheric variability and the relative importance of various mechanisms responsible for the time histories observed in total electron content (TEC), proportional to signal group delay, and in irregularity formation are discussed in terms of capability to make both short and long term predictions. The data base upon which predictions are made is examined for its adequacy, and the prospects for prediction improvements by more theoretical studies as well as by increasing the available statistical data base are examined. J.M.S.

N80-24696*# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
LONG-TERM SOLAR ACTIVITY PREDICTIONS **c92**
P. S. McIntosh, G. M. Brown, R. Buhmann, T. Clark, P. F. Fougere, H. Hunter, J. V. Lincoln, H. H. Sargent, III, J. G. Timothy, and Y. Z. Lin *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 246-257 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

The need for long term solar activity predictions is addressed. The spatial organization of solar activity is described including applications for predictions, and ancient evidence for solar variability. Methods of predicting sunspot numbers are discussed. The inherent accuracy of the methods varies considerably, but a typical error bar 20%. The accuracy of sunspot cycle predictions is considered along with long term predictions of great solar events. J.M.S.

N80-24697*# Main Astronomical Observatory, Pulkovo (USSR).
A NEW METHOD OF VERY LONG-TERM PREDICTION OF SOLAR ACTIVITY **c92**
A. I. Ohl and G. I. Ohl (Arkticheskii i Antarkticheskii Nauchno-Issled. Inst.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 258-263 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

A method of solar activity prediction based on the statistical relationship between the minimum value of geomagnetic activity in each 11 year cycle and the height of the next sunspot cycle is proposed. The method is applied to predict sunspot cycle 21. J.M.S.

N80-24698*# University Coll. of Wales, Aberystwyth. Dept. of Physics.
NEW METHODS FOR PREDICTING THE MAGNITUDE OF SUNSPOT MAXIMUM **c92**
G. M. Brown *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 264-279 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

Three new and independent methods of predicting the magnitude of a forthcoming sunspot maximum are suggested.

The longest lead time is given by the first method, which is based on a terrestrial parameter measured during the declining phase of the preceding cycle. The second method, with only a slightly shorter foreknowledge, is based on an interplanetary parameter derived around the commencement of the cycle in question (sunspot minimum). The third method, giving the shortest prediction lead-time, is based entirely on solar parameters measured during the initial progress of the cycle in question. Application of all three methods to forecast the magnitude of the next maximum (Cycle 21) agree in predicting that it is likely to be very similar to that of Cycle 18. Author

N80-24699*# Colorado Univ., Boulder. Atmospheric and Space Physics Lab.

THE VARIABILITY OF THE SOLAR ULTRAVIOLET SPECTRAL IRRADIANCES **c92**

J. Gethyn Timothy *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 280-321 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 03B

Available data on the solar spectral irradiances at wavelengths below 3100 A are extremely limited and there are major uncertainties in many of the measurements. In particular, there is major disagreement on the magnitude of the variability of the spectral irradiances over the solar cycle. The effects of different solar features on the ultraviolet spectral irradiances over both the 28 day solar rotation period and over the solar cycle are discussed. It is proposed that any attempt to predict the magnitudes of the ultraviolet spectral irradiances must take into account a long term variability of emission from quiet regions of the solar disk over the solar cycle. The need for direct long term monitoring of the ultraviolet spectral irradiances is emphasized. J.M.S.

N80-24700*# Astronomical Inst., Utrecht (Netherlands). Space Research Lab.

THE NEEDS FOR PREDICTION AND REAL-TIME MONITORING FOR THE FLARE BUILD-UP STUDY **c92**

Zdenek Svestka *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 322-330 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 03B

Similarities between plasma instabilities occurring in the magnetospheric tail and in active regions on the Sun are discussed. Intense observations of the flare build-up processes on the Sun planned for May and June 1980 as a part of the Solar Maximum Year are described. J.M.S.

N80-24701*# American Science and Engineering, Inc., Cambridge, Mass.

SOLAR FORECAST AND REAL-TIME MONITORING NEEDS OF THE STUDY OF ENERGY RELEASE IN FLARES (SERF) **c92**

David M. Rust *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 331-339 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 03B

Complementary, simultaneous observations of flares from as many observatories, both ground based and orbiting, as possible planned for the Solar Maximum Year are considered. The need for forecasts of solar activity on long term, one week, and two day intervals is described. Real time reporting is not needed, but daily summaries of activity and permanent records are important. J.M.S.

N80-24702*# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.

REQUIREMENTS FOR PREDICTIONS AND REAL-TIME MONITORING FOR THE STUDY OF TRAVELLING INTERPLANETARY PHENOMENA **c90**

Murray Dryer and M. A. Shea (AFGL, Hanscom AFB, Mass.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 340-345 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 03B

Physical processes within quiescent as well as disturbed flows of solar wind plasma, energetic particles, and magnetic and electric fields from the Sun are considered. Specifically, travelling interplanetary phenomena to be studied during the years of the solar maximum of solar cycle 21 are covered. It is noted that predictions, while needed for long range, logistical planning, is secondary to the requirements of synoptic real time monitoring over a wide range of particle energies and spectral bandwidths. J.M.S.

N80-24703*# National Aeronautics and Space Administration, Washington, D. C.

SOLAR WIND AND MAGNETOSPHERE INTERACTIONS **c92**

C. T. Russell (California Univ., Los Angeles), J. H. Allen (Environmental Data Serv., Boulder, Colo.), D. P. Cauffman, J. Feynman (Boston Coll.), E. W. Greenstadt (TRW Systems Group, Redondo Beach, Calif.), R. E. Holzer (California Univ., Los Angeles), S. M. Kaye (California Univ., Los Angeles), J. A. Slavin (California Univ., Los Angeles), R. H. Manka (NSF), G. Rostoker (Alberta Univ., Edmonton) et al *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 346-364 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 03B

The relationship between the magnetosphere and the solar wind is addressed. It is noted that this interface determines how much of the solar plasma and field energy is transferred to the Earth's environment, and that this coupling not only varies in time, responding to major solar disturbances, but also to small changes in solar wind conditions and interplanetary field directions. It is recommended that the conditions of the solar wind and interplanetary medium be continuously monitored, as well as the state of the magnetosphere. Other recommendations include further study of the geomagnetic tail, tests of Pc 3,4 magnetic pulsations as diagnostics of the solar wind, and tests of kilometric radiation as a remote monitor of the auroral electrojet. J.M.S.

N80-24704*# California Univ., Los Angeles. Dept. of Earth and Space Sciences.

ON THE PREDICTION OF MAGNETOSPHERIC CONFIGURATION **c46**

James A. Slavin and Robert E. Holzer *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 365-374 refs (For primary document see N80-24678 15-42)

(Grants NGR-05-007-276; NSF ATM-75-01431)

Avail: NTIS HC A99/MF A01 CSCL 04A

A simple model of magnetic flux transfer is reviewed along with empirical expressions for flux transfer rates based upon the auroral AL index and the eastward component of the interplanetary electric field. It is shown that the magnitude of the time integral of the AL index over isolated intervals of geomagnetic disturbance can be predicted from the the observed flux of southward interplanetary magnetic field lines incident on the front of the magnetosphere. Difficulties in the quantitative prediction of substorm onset time and intensity are discussed and magnetospheric stress index on both solar wind and ground based observations is proposed for this purpose. Finally, caveats concerning the use of both the AL index and interplanetary medium data in predicting the response of the magnetosphere to solar wind conditions are considered. J.M.S.

N80-24705*# California Univ., Los Angeles. Dept. of Earth and Space Sciences.

THE MAGNETOSPHERIC ELECTRIC FIELD AND CONVECTIVE PROCESSES AS DIAGNOSTICS OF THE IMF AND SOLAR WIND **c92**

Stanley M. Kaye *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 375-384 refs (For primary document see N80-24678 15-42)

(Grants NsG-7295; NGL-05-007-004; NSF DES-74-23464)

Avail: NTIS HC A99/MF A01 CSCL 03B

Indirect measurements of the convection field as well as direct of the ionospheric electric field provide a means to at least monitor quantitatively solar wind processes. For instance, asymmetries in the ionospheric electric field and ionospheric Hall currents over the polar cap reflect the solar wind sector polarity. A stronger electric field, and thus convective flow, is found on the side of the polar cap where the y component of the IMF is parallel to the y component of the geomagnetic field. Additionally, the magnitude of the electric field and convective southward B

sub Z and/or solar wind velocity, and thus may indicate the arrival at Earth of an interaction region in the solar wind. It is apparent that processes associated with the convention electric field may be used to predict large scale features in the solar wind; however, with present empirical knowledge it is not possible to make quantitative predictions of individual solar wind or IMF parameters. J.M.S.

N80-24706*# National Oceanic and Atmospheric Administration, Boulder, Colo.

REVIEW OF SELECTED GEOMAGNETIC ACTIVITY INDICES c46

Joe H. Allen and J. Feynman (Boston Coll.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 385-398 refs (For primary document see N80-24678 15-42)

(Contract F19628-79-C-0031)

Avail: NTIS HC A99/MF A01 CSCL 04A

Magnetic activity indexes are reviewed. Classifications of magnetograms from single observatories and the global range of potential associated with the equivalent currents which could have produced the variations monitored at a large array of recording sides are addressed. Principal magnetic activity indexes discussed include: the auroral electrojet index and its associated indexes (AU, AL and AO) useful for auroral zone studies; the Kp, ap, as and am indexes which are measures of midlatitude geomagnetic activity; and the Dst index of magnetic activity recorded at low latitudes. It is concluded that geomagnetic activity indexes are useful in studies of the interaction between solar activity, the interplanetary magnetic field and solar wind, the magnetosphere, ring current, field aligned currents, and ionospheric currents. J.M.S.

N80-24707*# Air Force Geophysics Lab., Hanscom AFB, Mass.

THE PREDICTION OF AE, ap, AND Dst AT TIME LAGS BETWEEN 0 AND 30 HOURS c46

D. F. Smart, H. B. Garrett, and M. A. Shea *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 399-414 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 04A

The magnetic activity indexes AE, ap, and Dst are correlated with approximately 35,000 hours of interplanetary plasma and magnetic field measurements acquired near the Earth (assembled by NASA/NSSDC into a composite data set). Lag times between the indexes and solar wind parameters ranged from 0 to 30 hours. Correlations at lags less than 6 hours yield results in agreement with previous studies. At greater lags, the correlation coefficients between the solar wind parameters and AE and ap approach these parameters' autocorrelation (persistence) values. For Dst the correlation with solar wind parameters is lower than that with AE and ap in the 3 to 4 hour lag range whereas the autocorrelation of Dst is significantly higher over the entire 0 to 30 hour lag range. The implications of these differences between AE, ap, and Dst are discussed in terms of persistence of solar wind structure. J.M.S.

N80-24708*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PREDICTION OF ENERGETIC PARTICLE DISTURBANCES c93

G. A. Paulikas (Aerospace Corp., Los Angles, Calif.), D. N. Baker (LASL), W. R. Barron (AFGL), V. Domingo (European Space Technol. Center, Noordwijk, Netherlands), P. R. Higbie (LASL), W. L. Imhof (LMSC, Palo Alto, Calif.), L. R. Lyons, R. L. McPherron, E. C. Roelof (APL/JHU, Laurel, Md.), M. Scholer (Max-Planck-Inst. fuer Phys. und Astrophys., Munich, West Germany) et al *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 415-432 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 03B

The prediction of fluxes of energetic particles of solar or magnetospheric origin is addressed. Topics include the prediction of the properties of the particle populations generated by magnetospheric storms and substorms, and the prediction of long term variations in the populations of magnetospheric particles. E.D.K.

N80-24709*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SHORT TERM MAGNETOSPHERIC PARTICLE VARIATIONS (1 MINUTE < T < 1 DAY), APPENDIX 1 c46

P. R. Higbie (LASL), D. N. Baker (LASL), V. Domingo (European Space Technol. Center., Noordwijk, Netherlands), W. L. Imhof (LMSC, Palo Alto, Calif.), R. L. McPherron (California Univ., Los Angeles), W. N. Srjeldvik (NOAA, Boulder, Colo.), D. J. Williams (NOAA, Boulder, Colo.), J. R. Burrows (Herzberg Inst. of Astrophysics), M. Hayakawa (Nagoya Univ.) et al *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 433-440 (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 04A

A schematic representation of the generation and propagation processes for energetic particles of concern in solar terrestrial predictions is given. Particle precipitation at low, mid, and high altitudes is discussed with emphasis on prediction techniques. Methods given for testing of such techniques include traditional collaborations, enhanced collaborations, simulated prediction schemes, and field tests. E.D.K.

N80-24710*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LONG TERM MAGNETOSPHERIC PARTICLE VARIATIONS (1 DAY < T < INFINITY), APPENDIX 2 c46

J. I. Vette, H. K. Hills, G. A. Paulikas (Aerospace Corp., Los Angeles, Calif.), D. A. Sawyer, E. G. Stassinopoulos, M. J. Teague et al *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 441-445 (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 04A

Effects of solar variations on energetic particle propagation are discussed, as well as prediction techniques for such particles within the magnetosphere. Magnetic field models, magnetic energy stored in the tail, magnetic monitoring measurements in the geostationary orbit and at certain ground based stations are important elements concerning improving such techniques.E.D.K.

N80-24711*# Max-Planck-Institut fuer Extraterrestrische Physik, Munich (West Germany).

ENERGETIC SOLAR PARTICLE BEHAVIOUR IN THE MAGNETOSPHERE c46

M. Scholer *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 446-463 refs (For primary document see N80-24678 15-42)

Avail: NTIS HC A99/MF A01 CSCL 04A

The behavior of energetic solar flare particles in the magnetosphere is discussed. In the absence of magnetospheric motion, the problem of particle transport can be treated as simple propagation of charged particles in a stationary magnetic field configuration using, for instance, trajectory calculations in model fields. This single particle approach is the basis for the determination of intensity and anisotropy structures over the polar caps and in the geomagnetic tail from different interplanetary conditions. Particle transport on closed field lines is in addition strongly affected by resonant interaction processes as pitch angle scattering and radial diffusion. Author

N80-24712*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A REAL-TIME ISEE DATA SYSTEM c46

Bruce T. Tsurutani and Daniel N. Baker (LASL) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 464-475 refs Sponsored in part by DOE (For primary document see N80-24678 15-42)

(Contract NAS7-100)

Avail: NTIS HC A99/MF A01 CSCL 04A

A real time International Sun Earth Explorer (ISEE) data system directed toward the prediction of geomagnetic substorms and storms is discussed in detail. Such a system may allow up to 60 minutes or more, advance warning of magnetospheric substorms and up to 30 minute warnings of geomagnetic storms induced by high speed streams and solar flares. The proposed system utilizes existing capabilities of several agencies thereby minimizing costs. E.D.K.

N80-24713*# SRI International Corp., Menlo Park, Calif.
MAGNETOSPHERE-IONOSPHERE INTERACTIONS c46
R. R. Vondrak, Y. T. Chiu (Aerospace Corp., Los Angeles, Calif.), D. S. Evans (NOAA, Boulder, Colo.), V. G. Patterson (AF Global Weather Central), G. J. Romick (Alaska Univ., College), and K. Stasiewicz (Polish Acad. of Science, Warsaw) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 476-493 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

The present understanding of magnetosphere ionosphere interactions is described, and present and future predictive capabilities are assessed. Ionospheric features directly coupled to the magnetosphere to a significant degree are considered, with emphasis given to those phenomena of major interest to forecasters and users. E.D.K.

N80-24714*# Aerospace Corp., Los Angeles, Calif. Space Sciences Lab.
AURORAL MAGNETOSPHERE-IONOSPHERE COUPLING: A BRIEF TOPICAL REVIEW c46
Y. T. Chiu, J. M. Cornwall (California Univ., Los Angeles), and Michael Schulz *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 494-512 refs (For primary document see N80-24678 15-42)
(Contract NASw-3120)
Avail: NTIS HC A99/MF A01 CSCL 04A

Auroral arcs result from the acceleration and precipitation of magnetospheric plasma in narrow regions characterized by strong electric fields both perpendicular and parallel to the Earth's magnetic field. The various mechanisms proposed for the origin of such strong electric fields include electrostatic double layers, double reverse shocks, anomalous resistivity, magnetic mirroring of hot plasma, mapping of the magnetospheric convection electric field through an auroral discontinuity. E.D.K.

N80-24715*# Alaska Univ., College. Geophysical Inst.
HIGH-LATITUDE E AND F REGION IONOSPHERIC PREDICTIONS c46
Robert D. Hunsucker, R. Allen, P. Argo, R. Babcock, P. Bakshi, D. Lund, S. Matsushita, G. Smith, A. V. Shirochkov, and G. Wortham *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 513-527 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

The physical processes and morphology of the high latitude E and F layers are discussed. The existence and adequacy of models, and features to be included are examined, as well as reliability of ionospheric predictions. E.D.K.

N80-24716*# Articheskii i Antarkticheskii Nauchno- Issledovatelskii Institut, Leningrad (USSR).
ON THE APPROACH TO FORECASTING POLAR IONOSPHERIC CONDITIONS c46
A. S. Besprozvannaya, A. V. Shirochkov, and T. I. Shchuka *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 528-542 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

The major properties of polar ionospheric main anomalous events are summarized. The monitoring of large scale features of the ionization distribution that are the projections of large scale structural characteristics of magnetospheric plasma on the upper ionosphere is suggested as a basic principle of polar ionospheric condition forecasting. It is concluded that the processes of the magnetosphere/ionosphere interaction appear to play a predominant role in the creation of the polar ionosphere. Author

N80-24717*# Alaska Univ., Fairbanks. Geophysical Inst.
MORPHOLOGY AND PHENOMENOLOGY OF THE HIGH-LATITUDE E AND F REGIONS c46
Robert D. Hunsucker *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 543-561 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

Results obtained at high latitude observatories on the behavior of E and F region ionization are presented including a bibliography. Behavior of E and F region ionization during day and night for quiet and disturbed conditions in the auroral and polar regions is described. Daily, seasonal and sunspot variations are also outlined. J.M.S.

N80-24718*# National Telecommunication Information Administration, Boulder, Colo. Inst. of Telecommunications Sciences.
REPORT OF THE MID- AND LOW-LATITUDE E AND F REGION WORKING GROUP c46
Charles M. Rush *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 562-572 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

The formation and variation of the ionosphere is addressed with regard to the ability to understand, specify, and predict the low and mid latitude E and F regions. A brief survey of prediction methods and techniques is given for long and short term variability in the E and F regions. It is indicated that the usefulness of theoretical models to predict electron density distribution in the low and mid latitude ionospheric E and F regions is limited by the ability to predict the parameters which enter the relevant equations; i.e., neutral atmospheric constituents, neutral and charged particle temperatures, neutral wind, electric fields, and ionizing sources such as solar (E sub uv) radiation and energetic particles. It is recommended that areas for research include improving knowledge of the input parameters and how they respond to changing solar and geophysical conditions. J.M.S.

N80-24719*# Norwegian Defence Research Establishment, Kjeller. Electronics Div.
D REGION PREDICTIONS c46
E. V. Thrane, D. K. Chakrabarty (Phys. Res. Lab.), S. D. Deshpande (Dept. of Appl. Phys., Coll. of Eng., India), R. H. Doherty (Colo. Res. and Prediction Lab.), J. B. Gregory (Saskatchewan Univ.), J. K. Hargreaves (Lancaster Univ.), J. Lastovicka, Peter Morris (Coast Guard, Washington, D.C.), W. R. Piggott (British Antarctic Surv.), and J. B. Reagan (LMSC, Palo Alto, Calif.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 573-598 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

Present knowledge of D region phenomena is briefly reviewed and the status of current methods of predicting their effects on radio propagation considered. The ELF, VLF and LF navigational and timing systems depend on the stability of the lower part of the D layer where these waves are reflected, whereas MF and HF waves are absorbed as they penetrate the region, in most cases mainly in the upper part of the layer. Possible methods of improving predictions, warnings, and real time operations are considered with particular stress on those which can be implemented in the near future. J.M.S.

N80-24720*# Air Force Geophysics Lab., Hanscom AFB, Mass.
ION PRODUCTION IN THE D REGION c46
William Swider *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 599-616 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

Ionization processes for the D region are reviewed. Levels of ionization range from the fairly steady rates produced through galactic cosmic rays to the large rates generated during solar flares and associated geomagnetic storms. The normal quiescent daytime D region is ionized by solar UV radiation available because of certain windows and solar X-rays, although this later source is generally weak. Cosmic rays are important roughly below 65 km. At night, stellar X-ray sources may be important along with precipitating electrons at high latitudes from the quiet magnetosphere. Solar flares can result in ionization rates due to X-rays, electrons, or nuclei which are greatly enhanced over quiet conditions. Typical ionization production rates from these various sources are illustrated. Author

N80-24721*# Norwegian Defence Research Establishment, Kjeller.
EFFECTS OF D REGION IONIZATION ON RADIO WAVE PROPAGATION c32
T. R. Larsen *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 617-654 refs (For

primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 20N

The effects of anomalous D region ionization upon radio wave propagation are described for the main types of disturbances: sudden ionospheric disturbances, relativistic electron events, magnetic storms, auroral disturbances, polar cap events, and stratospheric warmings. Examples of radio wave characteristics for such conditions are given for the frequencies between the extremely low (3-3000 Hz) and high (3-30 MHz) frequency domains. Statistics on the disturbance effects and radio wave data are given in order to contribute towards the evaluation of possibilities for predicting the radio effects. Author

N80-24722*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR WEATHER/CLIMATE PREDICTIONS c47
K. Schatten (Boston Univ.), Richard A. Goldberg, J. M. Mitchell (NOAA, Silver Spring, Md.), R. Olson (Aspen Inst. for Humanistic Studies, Boulder, Colo.), J. Schaefer (Bonn Univ.), S. Silverman (AFGL), J. Wilcox (Stanford Univ.), and G. Williams (Southampton Univ.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 655-668 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04B

Solar variability influences upon terrestrial weather and climate are addressed. Both the positive and negative findings are included and specific predictions, areas of further study, and recommendations listed. J.M.S.

N80-24723*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COUPLING PROCESSES RELATED TO THE SUN-WEATHER PROBLEM c47
Richard A. Goldberg and John R. Herman (Radio Sci. Co., Melbourne, Fla.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 689-688 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04B

Physical mechanisms for coupling the energetics of solar activity to meteorological responses are reviewed. Although several hypotheses have been advanced, none can be said to be sufficiently complete to be applied to weather or climate prediction. Solar activity indicators potentially useful for forecasting are identified, including sunspots, solar flares, and magnetic sector boundary crossings. Additional experiments, studies, and analyses are required before Sun-weather concepts can be utilized for predicting meteorological responses. Author

N80-24724*# Cornell Univ., Ithaca, N. Y. Atmospheric Sciences Div.
THE IMPACT OF SUN-WEATHER RESEARCH ON FORECASTING c47
Miguel F. Larsen *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 689-702 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04B

The possible impact of Sun-weather research on forecasting is examined. The type of knowledge of the effect is evaluated to determine if it is in a form that can be used for forecasting purposes. It is concluded that the present understanding of the effect does not lend itself readily to applications for forecast purposes. The limits of present predictive skill are examined and it is found that skill is most lacking for prediction of the smallest scales of atmospheric motion. However, it is not expected that Sun-weather research will have any significant impact on forecasting the smaller scales since predictability at these scales is limited by the finite grid size resolution and the time scales of turbulent diffusion. The predictability limits for the largest scales are on the order of several weeks although presently only a one week forecast is achievable. J.M.S.

N80-24725*# Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
PLANETARY WAVES AND SUN-WEATHER EFFECTS c47
H. Volland and J. Schaefer (Bonn Univ.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 703-721 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04B

A brief outline about the theory of planetary waves is given and a review of space-time analysis, mainly at the 500 mbar pressure level, is presented. This analysis gives evidence that broad spectral bands of two types of waves exist within the troposphere: ultralong waves with zonal wave numbers M < or approximately equal to 4 and periods tau > or approximately equal to 5 days, propagating mainly to the west, and synoptic scale waves with M > or approximately equal to 3 and tau < or approximately equal to 10 days, propagating mainly to the east. These waves are generated by internal turbulent processes within the atmosphere and are quasi-persistent with lifetimes of several periods. It is shown that solar activity cannot generate planetary waves of significant amplitudes, and that the observed 'Sun-weather effects' can be interpreted within the framework of these internally generated planetary waves without any trigger mechanism from outside the atmosphere. It is suggested that a better knowledge of these persistent ultralong waves may help to improve long range weather forecasts. J.M.S.

N80-24728*# Air Force Geophysics Lab., Hanscom AFB, Mass.
THE CLOUDED CRYSTAL BALL: COMMENTS ON GEOPHYSICAL PREDICTION
S. M. Silverman *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 722-733 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

The concepts of prediction in the geophysical domain are considered with emphasis on the areas of difficulties and the nature of these difficulties. Differences in defining and determining the validity and significance of hypotheses and observational correlations are covered. J.M.S.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see 35 Instrumentation and Photography.

N80-24727* National Aeronautics and Space Administration, Washington, D. C.
EARTH RESOURCES. A CONTINUING BIBLIOGRAPHY WITH INDEXES, ISSUE 25, APRIL 1980
Apr. 1980 109 p
(NASA-SP-7041(25)) Avail: NTIS HC $10.50 CSCL 05B

The bibliography lists 380 reports, articles, and other documents introduced into the NASA scientific and technical information system between January 1, 1980 and March 31, 1980. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis. Author

N80-24728*# Energy and Environmental Analysis, Inc., Arlington, Va.
FORECAST OF LONG TERM COAL SUPPLY AND MINING CONDITIONS: MODEL DOCUMENTATION AND RESULTS Final Report
7 Mar. 1980 240 p refs Sponsored by NASA and DOE Prepared for JPL
(Contract JPL-955552)
(NASA-CR-163141; JPL-9950-310) Avail: NTIS HC A11/MF A01 CSCL 08I

A coal industry model was developed to support the Jet Propulsion Laboratory in its investigation of advanced underground coal extraction systems. The model documentation includes the programming for the coal mining cost models and an accompanying users' manual, and a guide to reading model output. The methodology used in assembling the transportation, demand, and coal reserve components of the model are also described. Results presented for 1986 and 2000, include projections of coal

production patterns and marginal prices, differentiated by coal sulfur content. A.R.H.

N80-24729# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DISTRIBUTED SENSOR NETWORKS Semiannual Technical Summary Report, 1 Oct. 1978 - 31 Mar. 1979
Richard T. Lacoss 31 Mar. 1979 56 p refs
(Contract F19628-78-C-0002; ARPA Order 3345)
(AD-A082395; ESD-TR-79-211) Avail: NTIS HC A04/MF A01 CSCL 15/4

Progress on the Distributed Sensor Networks program is reported. Further design and analysis of strawman sensor and report circuit communications for a low flying aircraft DSN are presented. System studies dealing with sensor redundancy, adaptive communications nonuniform node distribution, and alternative DSN applications are summarized. Overall designs for DSN node software, for a software development DSN simulation test bed, and acoustic node front-end simulation software are reviewed. Progress on development of a digital acoustic data collection system is reported. GRA

N80-24730# Army Engineer Topographic Labs., Fort Belvoir, Va.
DETECTION OF SIGNAL SIGNATURES OF CARTOGRAPHIC FEATURES
Fi-Fuay Chen and William Seemuller 17 Jan. 1980 19 p refs
(AD-A082235; ETL-R006) Avail: NTIS HC A02/MF A01 CSCL 08/2

A semi-automated technique was developed for extracting and recognizing cartographic features, such as, road intersections, straight line roads, and rectangular objects from aerial photographs. The method uses the Walsh transform processing technique, and was implemented with an electronic experimental system consisting of a solid-state sensor array, a minicomputer, and a computer-controlled translational stage as the imagery holder. Successful experimental results were obtained for a selected set of cartographic features of the types described above. This feature extractor will be integrated in parallel with other feature extractors, which are to be developed in the future, to become a total automated feature extraction system. A method for detecting the decomposed signal signatures representing cartographic features using analog processors is described. Finally, conclusions are given. GRA

N80-24731# Army Engineer Topographic Labs., Fort Belvoir, Va.
CARTOGRAPHIC RASTER PROCESSING PROGRAMS AT USAETL
Richard A. Clark 8 Jan. 1980 19 p
(AD-A082236; ETL-R005) Avail: NTIS HC A02/MF A01 CSCL 08/2

The raster processing activities at USAETL have been concerned with both hardware and software development aimed at high-speed generation of topographic data base information and graphic map production. Early work with raster digitizing techniques resulted in the development of the Cartographic Scanner/Plotter which provides a multi-resolution, rapid capability of digitizing or film plotting. Software to process these raster data has been developed for sequential computers as well as for the STARAN: associative array processor. Recently completed programs for the STARAN permit the processing of raster-scanned contour sheets, the semi-automatic determination and tagging of elevations for the contours, and interpolation of these tagged contours into a uniform grid of elevations. Work has also been started on algorithm development for automatic detection of cartographically symbolized raster scan data. STRAPS programming improvements are under way which will provide expanded capabilities in the vector-to-raster and raster symbolization areas. The soon to be delivered Digital Laser Platemaker will provide a totally new capability to go directly from raster formatted data to press plates, eliminating the film preparation stages entirely. An inherent capability also exists in the laser platemaker to produce quick, self-developing proof plots and conventional film plots for back-up purposes, as well as to receive data via satellite for remote operations. GRA

N80-24732# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C.
CHART MODIFICATION AND REPRODUCTION WITH A RASTER SYSTEM
Jan S. Schneier Jan. 1980 23 p refs Presented at the Am. Congr. on Surveying and Mapping/ASP Conf., St. Louis, 9-14 Mar. 1980
(AD-A082103) Avail: NTIS HC A02/MF A01 CSCL 14/5

The Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC) acquired the SCI-TEX Response 250 Mapping System (R250/MS) to facilitate the production of modified facsimile charts. Currently, a preliminary evaluation indicates that the system is capable of producing the modified color-separated reproducibles required for the production of modified facsimile charts. Editing of a raster file remains the most time-consuming phase of the production flow. Standard operating procedures to reduce edit time and scanning procedures to reduce the amount of spurious data are currently being established. The addition of font, symbol, and text libraries will further increase the capabilities of the R250/MS. Following the establishment of the system in the modified facsimile reproduction process, other avenues of cartographic applications will be explored. GRA

N80-24733# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C.
AUTOMATED CARTOGRAPHIC PRODUCTS
Mary G. Clawson Jan. 1980 17 p Presented at the Am. Congr. on Surveying and Mapping/ASP Conf., St. Louis, 9-14 Mar. 1980
(AD-A082107) Avail: NTIS HC A02/MF A01 CSCL 08/2

The Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC) is engaged in researching, planning, compiling, and constructing charts, digital graphics and data bases, and plotter-derived support products through the use of the Advanced Cartographic Production System (ACPS). This presentation highlights the cartographic products generated in support of the military and civil mapping requirements. GRA

N80-24734# Naval Surface Weapons Center, Dahlgren, Va. Science and Mathematics Research Group.
TERRESTRIAL AND CELESTIAL CARTOGRAPHY
A. V. Hershey May 1979 69 p refs
(AD-A082663; NSWC/DL-TR-3789) Avail: NTIS HC A05/MF A01 CSCL 08/2

World Data Bank 1 has been reordered in such a way that the latitudes where coastlines cross meridians are sorted in order of latitude for each minute of longitude. Whether a satellite position is over sea or over land is determined by the parity of the next lower crossing. Stellar data on distance and velocity as well as direction are given in a small catalog. Boundary data for Moon maria, constellations, and the Milky Way are given in a set of files. GRA

N80-24735# Department of Energy, Washington, D. C.
UNCONVENTIONAL GAS RECOVERY - ENHANCED GAS RECOVERY
Oct. 1979 71 p refs
(DOE/EDP-0049) Avail: NTIS HC A04/MF A01

The development of gas recovery methods that will make it economically possible to produce gas resources that are currently uneconomic is examined including resource targets for future development. Processes developed and tested to assist conventional gas extraction processes in the recovery of unconventional gas resources include advanced hydraulic fracturing, chemical explosive fracturing, and directionally deviated wells. The technology program, commercialization plan for unconventional gas recovery, environmental concerns and requirements, and environmental strategy are among the topics discussed. DOE

N80-24736# Department of Energy, Washington, D. C. Office of Leasing Policy Development.
ANALYSIS OF EXPLORATION, DEVELOPMENT AND PRODUCTION ACTIVITY ON FEDERAL OUTER CONTINENTAL SHELF LEASES
J. A. Gribbin, G. M. Kaitz, S. W. Edwards, and K. W. Erickson Dec. 1979 152 p refs
(DOE/RA-0044) Avail: NTIS HC A08/MF A01

Because the Outer Continental Shelf Lands Act Amendments

of 1978 reconfirmed Congress' desire to ensure that persons holding Federal Outer Continental Shelf (OCS)leases act in a diligent manner to explore and develop the resources on these leases. The actual history of operations on all Federal OCS leases was examined. The primary objective of the analysis was to determine and to describe the actual record of exploration, development, and production activity on Federal OCS leases. The analysis was designed also to identify factors that influence the rate of this activity. DOE

NBO-24737# LKB Resources, Inc., Huntingdon Valley, Pa.
NURE AERIAL GAMMA-RAY AND MAGNETIC RECONNAISSANCE SURVEY, COLORADO-ARIZONA AREA: SALTON SEA NI 2-9, PHOENIX NI 12-7, EL CENTRO NI 2-12, AJO NI 12-10, LUKEVILLE NH 12-1 QUADRANGLES. VOLUME 1: NARRATIVE REPORT
Nov. 1979 258 p refs
(Contract EY-76-C-12-1664)
(GJBX-12(80)-Vol-1) Avail: NTIS HC A12/MF A01

A rotary-wing reconnaissance high sensitivity radiometric and magnetic survey, encompassing several 1:250,000 quadrangles in southwestern Arizona and southeastern California, was performed. The surveyed area consisted of approximately 9300 line miles. The radiometric data were corrected and normalized to 400 feet terrain clearance. The data were identified as to rock type by correlating the data samples with existing geologic maps. Statistics defining the mean and standard deviation of each rock type are presented as listings in volume 1 of this report. The departure of the data from its corresponding mean rock type is computed in terms of standard deviation units and is presented as computer listings in microfiche form. The local geology is described, and the magnetic and radiometric data is discussed and selected uranium anomalies are evaluated. DOE

NBO-24738# Royal Aircraft Establishment, Farnborough (England).
GEOMETRIC CORRECTION OF SATELLITE IMAGERY
J. M. Williams London HMSO Sep. 1979 31 p refs
(RAE-TR-79121; RAE-Space-569; BR72781) Avail: NTIS HC A03/MF A01

Imagery from LANDSAT and other remote sensing satellites suffers geometric distortion which requires correction. How ground control points can be used to determine the transformation between image coordinates and some known projection is described. These ground control points were located in the image and on a standard map, here a 1:50,000 ordnance survey map. Suitable models for performing the transformation and various interpolation techniques for resampling the transformed image are examined. As results, a set of photographic images is included to show the effects of the processing methods described.
Author (ESA)

NBO-24739# South Dakota State Univ., Brookings. Water Resources Research Inst.
MODEL DEVELOPMENT FOR PREDICTING SOIL MOISTURE BY THERMOGRAPHY
Jerald A. Tunheim Jan. 1980 64 p refs
(Contract DI-14-34-0001-7088)
(PB80-140569; W80-03007; OWRT-A-063-SDAK(1)) Avail: NTIS HC A04/MF A01 CSCL 08K

Experimental and theoretical investigations were carried out relating to the detection and mapping of soil moisture by the use of remote sensed thermal emittance data (thermography). Soil temperature profiles, thermal emittance, soil moisture and other pertinent data were collected for test plots under fallow and crop cover conditions. Data were always collected simultaneously for two plots with indentical surface conditions but one of the plots irrigated to create different soil moisture profiles. Calculations of surface temperature difference as a function of time for these soil moisture conditions were made utilizing a theoretical model. The functional form of the theoretical temperture difference with time were shown to be very close to the experimental apparent temperature difference for both crop cover and bare soil conditions. The general nature of additional parameters needed for the present model are also described.
GRA

NBO-24740# Bureau of Mines, Pittsburgh, Pa.
CORRECTION FACTORS FOR LOW VELOCITY AIRFLOW MEASUREMENTS IN MINES
Edward D. Thimons, Slavoljub D. Maksimovic, and Fred N. Kissell 1979 20 p refs
(PB80-137882; BM-RI-8400) Avail: NTIS HC A02/MF A01 CSCL 08I

The Bureau of Mines conducted in-mine tests to determine correction factors applicable to low velocity airflows (below 150 fpm) measured by the smoke cloud, vane anemometer, and oil of wintergreen tracer gas techniques. The average correction factors found for these methods of measurement were lower than those reported in the literature for use with higher velocity measurements. All tests measured airflows with controlled average velocities ranging from 50 to 100 fpm. Correction factors averaged about 0.75 for readings taken by the centerline smoke cloud method, remotely controlled and stickheld centerline anemometer, and split traverse stick-held anemometer. For handheld centerline anemometer and oil of wintergreen tracer gas readings, correction factors averaged about 0.67. Since special anemometers are needed to measure airflows in this low velocity range, and since proper calibration of these anemometers is difficult and expensive, the use of anemometers for low velocity measurement is impractical. On the other hand, smoke and oil of wintergreen give results as consistent as those obtained with specially calibrated, low velocity anemometers. Furthermore, they are easy to use and inexpensive.
GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels, and 85 Urban Technology and Transportation.*

NBO-24741* National Aeronautics and Space Administration. Pasadena Office, Calif.
METHOD OF MITIGATING TITANIUM IMPURITIES EFFECTS IN P-TYPE SILICON MATERIAL FOR SOLAR CELLS Patent
Amal M. Salama, inventor (to NASA) (JPL) Issued 6 May 1980 7 p Filed 31 Jan. 1979 Supersedes N79-17315 (17 - 08, p 1001) Sponsored by NASA
(NASA-Case-NPO-14635-1; US-Patent-4,210,622; US-Patent-Appl-SN-008212; US-Patent-Class-156-605; US-Patent-Class-156-617SP; US-Patent-Class-156-DIG.64; US-Patent-Class-136-89SG; US-Patent-Class-252-62.3E) Avail: US Patent and Trademark Office CSCL 10A

An economical way to reduce the deleterious effects of titanium, one of the impurities present in metallurgical grade silicon material, is disclosed. By adding copper to approximately the same concentration level of the titanium during the melting process, the conversion efficiency will be restored to about 99.3% of what it would have been if the single crystal silicon had been grown free of titanium impurities.
Official Gazette of the U.S. Patent and Trademark Office

NBO-24742*# PRC Systems Services Co., Huntsville, Ala.
SOLAR ARRAY SUBSYSTEMS STUDY Final Report, Mar. 1979 - May 1980
P. W. Richardson, F. Q. Miller, and M. B. Badgley 6 Jun. 1980 284 p
(Contract NAS3-21926)
(NASA-CR-159857) Avail: NTIS HC A13/MF A01 CSCL 10A

The effects on life cycle costs of a number of technology areas are examined for a LEO, 500 kW solar array. A baseline system conceptual design is developed and the life cycle costs estimated in detail. The baseline system requirements and design technologies are then varied and their relationships to life cycle

costs quantified. For example, the thermal characteristics of the baseline design are determined by the array materials and masses. The thermal characteristics in turn determine configuration, performance and hence life cycle cost. Author

N80-24743*# Materials Research, Inc., Centerville, Utah.
QUANTITATIVE ANALYSIS OF DEFECTS IN SILICON. SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE ARE SILICON SHEET TASK OF THE LOW-COST SOLAR ARRAY PROJECT Final Report
R. Natesh, J. M. Smith, T. Bruce, and H. A. Oidwai Apr. 1980 100 p refs Sponsored by NASA and DOE Prepared for JPL (Contract JPL-954977)
(NASA-CR-163140; MRI-276; DOE/JPL-954977-79/9) Avail: NTIS HC A05/MF A01 CSCL 10A

One hundred and seventy four silicon sheet samples were analyzed for twin boundary density, dislocation pit density, and grain boundary length. Procedures were developed for the quantitative analysis of the twin boundary and dislocation pit densities using a QTM-720 Quantitative Image Analyzing system. The QTM-720 system was upgraded with the addition of a PDP 11/03 mini-computer with dual floppy disc drive, a digital equipment writer high speed printer, and a field-image feature interface module. Three versions of a computer program that controls the data acquisition and analysis on the QTM-720 were written. Procedures for the chemical polishing and etching were also developed. R.E.S.

N80-24744*# Tao (William) and Associates, St. Louis, Mo.
SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT SAINT LOUIS, MISSOURI Final Report
Apr. 1980 68 p refs Sponsored by NASA
(Grant EG-77-G-01-4085)
(NASA-CR-161420) Avail: NTIS HC A04/MF A01 CSCL 10A

The solar heating and hot water system installed at the William Tao & Associates, Inc., office building in St. Louis, Missouri is described, including maintenance and construction problems, final drawings, system requirements, and manufacturer's component data. The solar system was designed to provide 50 percent of the hot water requirements and 45 percent of the space heating needs for a 900 sq ft office space and drafting room. The solar facility has 252 sq ft of glass tube concentrator collectors and a 1000 gallon steel storage tank buried below a concrete slab floor. Freeze protection is provided by a propylene glycol/water mixture in the collector loop. The collectors are roof mounted on a variable tilt array which is adjusted seasonally and is connected to the solar thermal storage tank by a tube-in-shell heat exchanger. Incoming city water is preheated through the solar energy thermal storage tank. R.E.S.

N80-24745*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.
COMPARISON OF INDOOR-OUTDOOR THERMAL PERFORMANCE FOR THE SUNPAK EVACUATED TUBE LIQUID COLLECTOR
Mar. 1980 48 p Sponsored by NASA
(Contract DEN-000006)
(NASA-CR-161421; Wyle-T:I-531-40-R) Avail: NTIS HC A03/MF A01 CSCL 10A

Performance data for current Sunpak production collectors is presented. The effects of an improved manifold are seen from the test results. The test results show excellent correlation between the solar simulator derived test results and outdoor test results. Also, because of different incident angle modifiers, the all-day efficiency of this collector with a diffuse reflector is comparable to the performance with the standard shaped specular reflector. R.E.S.

N80-24746*# General Electric Co., Philadelphia, Pa. Space Div.
SOLAR HEATING AND COOLING SYSTEM DESIGN AND DEVELOPMENT Final Report
Oct. 1979 106 p ref Sponsored in part by DOE
(Contract NAS8-32092)
(NASA-CR-161422) Avail: NTIS HC A06/MF A01 CSCL 10A

The design and development of marketable solar heating and cooling systems for single family and commercial applications is described. The delivery, installation, and monitoring of the prototype systems are discussed. Seven operational test sites are discussed in terms of system performance. Problems encountered with equipment and installation were usually due to lack of skills required for solar system installation. R.E.S.

N80-24747*# National Aeronautics and Space Administration. Pasadena Office, Calif.
SOLAR-HEATED FLUIDIZED BED GASIFICATION SYSTEM Patent Application
Shaik A. Qader, inventor (to NASA) (JPL) Filed 15 May 1980 13 p
(Contract NAS7-100)
(NASA-Case-NPO-15071-1; US-Patent-Appl-SN-150115) Avail: NTIS HC A02/MF A01 CSCL 10A

A solar-powered fluidized bed gasification system for gasifying carbonaceous material is disclosed. The system includes a solar gasifier which is heated by fluidizing gas and steam. Energy to heat the gas and steam is supplied by a high heat capacity refractory honeycomb which surrounds the fluid bed reactor zone. The high heat capacity refractory honeycomb is heated by solar energy focused on the honeycomb by solar concentrator through solar window. The fluid bed reaction zone is also heated directly by thermal contact to the high heat capacity ceramic honeycomb with the walls of the fluidized bed reactor. Provisions are also made for recovering and recycling catalysts used in the gasification process. A back-up furnace is provided for start-up procedures and for supplying heat to the fluid bed reaction zone when adequate supplies of solar energy are not available. NASA

N80-24748*# Engelhard Minerals and Chemicals Corp., Edison, N. J.
DURABILITY TESTING AT 5 ATMOSPHERES OF ADVANCED CATALYSTS AND CATALYST SUPPORTS FOR GAS TURBINE ENGINE COMBUSTORS Final Report
B. A. Olson, H. C. Lee, I. T. Osgerby, R. M. Heck, and H. Hess Apr. 1980 95 p refs
(Contracts NAS3-19416; Contract EF-77-A-01-2593)
(NASA-CR-159839; DOE/NASA/9416-80/2) Avail: NTIS HC A05/MF A01 CSCL 10A

The durability of CATCOM catalysts and catalyst supports was experimentally demonstrated in a combustion environment under simulated gas turbine engine combustor operating conditions. A test of 1000 hours duration was completed with one catalyst using no. 2 diesel fuel and operating at catalytically-supported thermal combustion conditions. The performance of the catalyst was determined by monitoring emissions throughout the test, and by examining the physical condition of the catalyst core at the conclusion of the test. Tests were performed periodically to determine changes in catalytic activity of the catalyst core. Detailed parametric studies were also run at the beginning and end of the durability test, using no. 2 fuel oil. Initial and final emissions for the 1000 hours test respectively were: unburned hydrocarbons (C3 vppm):0, 146, carbon monoxide (vppm):30, 2420; nitrogen oxides (vppm):5.7, 5.6. R.E.S.

N80-24749*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CHARACTERIZATION OF THREE TYPES OF SILICON SOLAR CELLS FOR SEPS DEEP-SPACE MISSIONS. VOLUME 2: CURRENT VOLTAGE CHARACTERISTICS OF SOLAREX TEXTURED P(+)8 TO 10 MIL, PLANAR P(+)8 TO 10 MIL AND PLANAR P(+)2 MIL CELLS AS A FUNCTION OF TEMPERATURE AND INTENSITY
A. F. Whitaker, S. A. Little, and V. A. Wooden Mar. 1980 91 p refs
(NASA-TM-78272) Avail: NTIS HC A05/MF A01 CSCL 10A

Three types of high performance silicon solar cells, textured P(+)8 to 10 mil, planar P(+)8 to 10 mil and planar P(+)2 mil were evaluated for their low temperature and low intensity (LTLI) performance. Sixteen cells of each type were subjected to 11 temperatures and 9 intensities. The textured P(+)8 to 10 mil cells provided the best performance both at 1 astronomical unit and at LTLI conditions. The average efficiencies of this cell were

14.5 percent at 1 solar constant/+25 C and 18.7 percent at 0.086 solar constant/-100 C. R.E.S.

N80-24750*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOLAR THERMAL POWER SYSTEMS POINT-FOCUSING THERMAL AND ELECTRIC APPLICATIONS PROJECTS. VOLUME 1: EXECUTIVE SUMMARY Annual Technical Report, fiscal year 1979
A. Marriott 15 Jan. 1980 36 p 2 Vol.
(Contracts NAS7-100; DE-AI01-79ET-20307; JPL Proj. 5103-93)
(NASA-CR-163147; DOE/JPL-1060-31-Vol-1; JPL-Pub-79-118-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 10A

The activities of the Point-Focusing Thermal and Electric Applications (PETEA) project for the fiscal year 1979 are summarized. The main thrust of the PFTEA Project, the small community solar thermal power experiment, was completed. Concept definition studies included a small central receiver approach, a point-focusing distributed receiver system with central power generation, and a point-focusing distributed receiver concept with distributed power generation. The first experiment in the Isolated Application Series was initiated. Planning for the third engineering experiment series, which addresses the industrial market sector, was also initiated. In addition to the experiment-related activities, several contracts to industry were let and studies were conducted to explore the market potential for point-focusing distributed receiver (PFDR) systems. System analysis studies were completed that looked at PFDR technology relative to other small power system technology candidates for the utility market sector. R.E.S.

N80-24751*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOLAR THERMAL POWER SYSTEMS POINT-FOCUSING DISTRIBUTED RECEIVER TECHNOLOGY PROJECT. VOLUME 2: DETAILED REPORT Annual Technical Report, fiscal year 1979
1 Apr. 1980 134 p refs Prepared in part by NASA. Lewis Res. Center, Cleveland, Ohio 2 Vol.
(Contracts NAS7-100; DE-AI01-79ET-20307; JPL Proj. 5104-61)
(NASA-CR-159715; DOE/JPL-1060-30-Vol-2; JPL-Pub-79-112-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 10A

The accomplishments of the Point-Focusing Distributed Receiver Technology Project during fiscal year 1979 are detailed. Present studies involve designs of modular units that collect and concentrate solar energy via highly reflective, parabolic-shaped dishes. The concentrated energy is then converted to heat in a working fluid, such as hot gas. In modules designed to produce heat for industrial applications, a flexible line conveys the heated fluid from the module to a heat transfer network. In modules designed to produce electricity the fluid carries the heat directly to an engine in a power conversion unit located at the focus of the concentrator. The engine is mechanically linked to an electric generator. A Brayton-cycle engine is currently being developed as the most promising electrical energy converter to meet near-future needs. R.E.S.

N80-24752*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RESULTS OF THE 1979 NASA/JPL BALLOON FLIGHT SOLAR CELL CALIBRATION PROGRAM
C. H. Seaman and R. S. Weiss 1 May 1980 17 p refs
(Contract NAS7-100)
(NASA-CR-163013; JPL-Pub-80-31) Avail: NTIS HC A02/MF A01 CSCL 10A

Calibration of solar cells to be used as reference standards in simulator testing of cells and arrays was accomplished. Thirty-eight modules were carried to an altitude of about 36 kilometers during the solar cell calibration balloon flight. E.D.K.

N80-24753*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE APPLICABILITY OF DOE SOLAR CELL AND ARRAY TECHNOLOGY TO SPACE POWER
John A. Scott-Monck, Paul M. Stella, and Paul A. Berman 1 May 1980 27 p refs
(Contract NAS7-100)
(NASA-CR-163143; JPL-Pub-80-29) Avail: NTIS HC A03/MF A01 CSCL 10B

An evaluation of the main terrestrial photovoltaic development projects was performed. Technologies that may have applicability to space power are identified. Where appropriate, recommendations are made for programs to capitalize on developed technology. It is concluded that while the funding expended by DOE is considerably greater than the space (NASA and DOD) budget for photovoltaics, the terrestrial goals and the means for satisfying them are sufficiently different from space needs that little direct benefit currently exists for space applications. R.E.S.

N80-24754*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FEDERAL POLICIES TO PROMOTE THE WIDESPREAD UTILIZATION OF PHOTOVOLTAIC SYSTEMS. SUPPLEMENT: REVIEW AND CRITIQUE
J. L. Smith 15 Apr. 1980 115 p
(Contracts NAS7-100; EX-76-A-29-1012)
(NASA-CR-163148; DOE/JPL-1012-45; JPL-80-32) Avail: NTIS HC A06/MF A01 CSCL 10A

Review comments of the Congressional report entitled 'Federal Policies to Promote the Widespread Utilization of Photovoltaic Systems' are presented. Responses to the review comments by the Jet Propulsion Laboratory, preparer of the Congressional report, are also presented. The Congressional report discussed various issues related to promoting the deployment of photovoltaic systems through the Federal Photovoltaic Program. Various program strategies and funding levels were examined. R.E.S.

N80-24755*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROPOSED METHOD FOR DETERMINING THE THICKNESS OF GLASS IN SOLAR COLLECTOR PANELS
Donald M. Moore 1 Mar. 1980 74 p refs
(Contracts NAS7-100; EX-76-A-29-1012)
(NASA-CR-163151; DOE/JPL-1012-41; JPL-Pub-80-34) Avail: NTIS HC A04/MF A01 CSCL 10A

An analytical method was developed for determining the minimum thickness for simply supported, rectangular glass plates subjected to uniform normal pressure environmental loads such as wind, earthquake, snow, and deadweight. The method consists of comparing an analytical prediction of the stress in the glass panel to a glass breakage stress determined from fracture mechanics considerations. Based on extensive analysis using the nonlinear finite element structural analysis program ARGUS, design curves for the structural analysis of simply supported rectangular plates were developed. These curves yield the center deflection, center stress and corner stress as a function of a dimensionless parameter describing the load intensity. A method of estimating the glass breakage stress as a function of a specified failure rate, degree of glass temper, design life, load duration time, and panel size is also presented. R.E.S.

N80-24756*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ELECTRIC VEHICLE PROPULSION SYSTEM'S IMPACT ON BATTERY PERFORMANCE: AN OVERVIEW
John M. Bozek, John J. Smithrick, Robert C. Cataldo, and John G. Ewashinka 1980 10 p refs Presented at the 3d Intern. Elec. Vehicle Exposition and Conf., St. Louis, 20-22 May 1980 (Contract EC-77-A-31-1044)
(NASA-TM-81515; DOE/NASA/1044-7; E-459) Avail: NTIS HC A02/MF A01 CSCL 10B

The performance of two types of batteries, lead-acid and nickel-zinc, was measured as a function of the charging and discharging demands anticipated from electric vehicle propulsion systems. The benefits of rapid high current charging were mixed: although it allowed quick charges, the energy efficiency was reduced. For low power (overnight) charging the current wave shapes delivered by the charger to the battery tended to have no effect on the battery cycle life. The use of chopper speed controllers with series traction motors resulted in a significant

reduction in the energy available from a battery whenever the motor operates at part load. The demand placed on a battery by an electric vehicle propulsion system containing electrical regenerative braking confirmed significant improvment in short term performance of the battery. R.E.S.

N80-24757*# Honeywell, Inc., Minneapolis, Minn.
SPECTROPHOTOVOLTAIC ORBITAL POWER GENERATION Final Report, Aug. 1979 - Feb. 1980
Joan R. Onffroy Feb. 1980 195 p refs
(Contract NAS8-33511)
(NASA-CR-161451; HONEYWELL-80SRC8) Avail: NTIS HC A09/MF A01 CSCL 10A

The feasibility of a spectrophotovoltaic orbital power generation system that optically concentrates solar energy is demonstrated. A dichroic beam-splitting mirror is used to divide the solar spectrum into two wavebands. Absorption of these wavebands by GaAs and Si solar cell arrays with matched energy bandgaps increases the cell efficiency while decreasing the amount of heat that must be rejected. The projected cost per peak watt if this system is $2.50/W sub p. R.E.S.

N80-24758*# Boeing Engineering and Construction, Seattle, Wash.
MOD-2 WIND TURBINE SYSTEM CONCEPT AND PRELIMINARY DESIGN REPORT. VOLUME 1: EXECUTIVE SUMMARY
Jul. 1979 31 p
(Contracts DEN3-2; DE-AI01-79ET-20305)
(NASA-CR-159609; DOE/NASA/0002-80/2) Avail: NTIS HC A03/MF A01 CSCL 10A

The configuration development of the MOD-2 wind turbine system is presented. The MOD-2 is design optimized for commercial production rates which, in multi-unit installations, will be integrated into a utility power grid and achieve a cost of electricity at less than 4 cents per kilowatt hour. R.E.S.

N80-24759*# Delaware Univ., Newark. Dept. of Chemical Engineering.
HEAT STORAGE IN ALLOY TRANSFORMATIONS
C. Ernest Birchenall Apr. 1980 29 p refs
(Grant NsG-3184; Contract EC-77-A-31-1034)
(NASA-CR-159787; DOE/NASA/3184-1) Avail: NTIS HC A03/MF A01 CSCL 10C

The feasibility of using metal alloys as thermal energy storage media was investigated. The elements selected as candidate media were limited to aluminum, copper, magnesium, silicon, zinc, calcium, and phosphorus on the basis of low cost and latent heat of transformation. Several new eutectic alloys and ternary intermetallic phases were determined. A new method employing X-ray absorption techniques was developed to determine the coefficients of thermal expansion of both the solid and liquid phases and the volume change during phase transformation. The method and apparatus are discussed and the experimental results are presented for aluminum and two aluminum-eutectic alloys. Candidate materials were evaluated to determine suitable materials for containment of the metal alloys. Graphite was used to contain the alloys during the volume change measurements. Silicon carbide was identified as a promising containment material and surface-coated iron alloys were also evaluated. System considerations that are pertinent if alloy eutectics are used as thermal energy storage media are discussed. Potential applications to solar receivers and industrial furnaces are illustrated schematically. R.E.S.

N80-24760*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCEEDINGS OF THE FIRST SEMIANNUAL DISTRIBUTED RECEIVER PROGRAM REVIEW
15 May 1980 241 p refs Proc. held at Lubbock, Tex., 22-24 Jan. 1980; sponsored in part by Texas Tech. Univ.
(Contracts NAS7-100; DE-AI01-79ET-20307)
(NASA-CR-163135; DOE/JPL-1060-33; JPL-Pub-80-10) Avail: NTIS HC A11/MF A01 CSCL 10B

Point focus and line focus distributed receiver solar thermal technology for the production of electric power and of industrial process heat is addressed. Concentrator, receiver, and power conversion development are covered along with hardware tests and evaluation. Mass production costing, parabolic dish applications, and trough and bowl systems are included. For individual titles, see N80-24761 through N80-24796.

N80-24761*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HEAT AND ELECTRICITY FROM THE SUN USING PARABOLIC DISH COLLECTOR SYSTEMS
Vincent C. Truscello and A. Nash Williams *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 19-26 refs (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

Point focus distributed receiver solar thermal technology for the production of electric power and of industrial process heat is addressed. The thermal power systems project which emphasizes the development of cost effective systems which will accelerate the commercialization and industrialization of plants up to 10 MWe, using parabolic dish collectors is described. The projected size of the isolated load market in the 1990-2000 time period is 300 to 1000 MW/year. Although this market is small in comparison to the grid connected utility market, it is indicated that by assuming only a 20 percent market penetration, up to 10,000 power modules per year would be required to meet this need. At a production rate of 25,000 units/year and assuming no energy storage, levelized bus bar energy costs of 75 mills/kWeh are projected. These numbers are based on what is believed to be a conservative estimate regarding engine-generator conversion efficiency (40 percent) for the 1990 time period. With a more optimistic estimate of efficiency (i.e., 45 percent), the bus bar cost decreases to about 67 mills/kWeh. At very large production rates (400,000 modules/years), the costs decrease to 58 mills/kWeh. Finally, the present status of the technology development effort is discussed. J.M.S.

N80-24762*# Sandia Labs., Albuquerque, N. Mex. Solar Energy Projects Dept.
LINE-FOCUS CONCENTRATING COLLECTOR PROGRAM
Virgil L. Dugan *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 27-33 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

The Line-Focus Concentrating Collector Program has emphasized the development and dissemination of concentrating solar technology in which the reflected sunlight is focused onto a linear or line receiver. Although a number of different types of line-focus concentrators were developed, the parabolic trough has gained the widest acceptance and utilization within the industrial and applications sectors. The trough is best applied for application scenarios which require temperatures between 140 and 600 F. Another concept, the bowl, is investigated for applications which may require temperatures in the range between 600 and 1200 F. Current technology emphases are upon the reduction of system installation cost and the implementation of production oriented engineering. J.M.S.

N80-24763*# E-Systems, Inc., Dallas, Tex. Energy Technology Center.
TEST BED CONCENTRATOR (TBC)
Vernon R. Goldberg *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 35-39 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

A point focussing concentrator design adapted from an existing communications antenna for use in a solar test bed application is described. The structure design, configured for use with JPL's spherical radius mirror panels, made no attempt toward optimization. The key objectives of stiffness, pointing accuracy, and timely delivery were exceeded. The system weight is approximately 16,000 Kg (36,000 lbs) and has a calculated 1 sigma system error of 0.03 degrees. J.M.S.

N80-24764*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TEST BED CONCENTRATOR MIRRORS
M. J. Argoud *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 41-46 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

The test bed concentrator (TBC) was des point focusing distributed receiver (PFDR) systems. The reflective surface of the concentrator was fabricated using mirror facet designs and techniques. The facets are made by bonding mirrored glass to spherically-conducted substrates. Several aspects of earlier work were reevaluated for application to the TBC: optimum glass block size, material selection, environmental test, optical characteristics, and reliability. A detailed explanation of tooling, substrate preparation, testing techniques, and mirror assembly is presented. J.M.S.

N80-24765*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INITIAL TEST BED CONCENTRATOR CHARACTERIZATION
D. J. Starkey *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 47-51 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

The operational characteristics and the mirror alignment technique of the test bed concentrator control system are highlighted. The final design of the TBC control system provided one axis of fast slew capability so that either the Sun acquisition or emergency off-Sun mode could be obtained in a minimum time. The procedure for getting on and off Sun is to run the elevation axis up to the approximate elevation of the Sun for the particular time of acquisition and then slew the concentrator on Sun in azimuth. The automatic Sun-acquisition system is controlled by two Sun sensors, one for each axis; each has a 2 deg acquisition cone angle within which the concentrators are programmed to point. The mirror alignment technique chosen utilized a semi-distant incandescent light source which produced a reflected image on the focal point target. The concentrator was boresighted to the light by moving the concentrator while sighting along the cross hairs and through the apertures in the disks to the light source resulting in a maximum point error of 0.11 deg. Test plans to install a solar flux mapper to characterize the solar spot and to measure the size, shape, and intensity of the Sun's image are outlined. J.M.S.

N80-24766*# OMNIUM-G Co., Anaheim, Calif.
THE OMNIUM-G HTC-25 TRACKING CONCENTRATOR
S. Zelinger *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 53-57 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

A point focusing, two axis tracking, high concentration ratio parabolic reflector is described. Field experience coupled with engineering improvements are shown to have manifested a design that is economic in the areas of manufacturing, packaging, delivering, installing, and commissioning the system into operation. The initial problems specifically with the OMNIUM-G model HTC-25 tracking concentrator are addressed. J.M.S.

N80-24767*# General Electric Co., Philadelphia, Pa. Advanced Energy Dept.
THE SHENANDOAH CONCENTRATOR
A. J. Poche *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 59-61 refs (For primary document see N80-24760 15-44)
(Contracts DE-AC04-77ET-2D260; EG-77-C-04-3985)
Avail: NTIS HC A11/MF A01 CSCL 10A

A 7 meter diameter, parabolic dish solar collector was designed and developed for first application at Shenandoah, Georgia. Key features and requirements for the collector are outlined. Performance test results for collector testing at Sandia Laboratories in Albuquerque are summarized. The key features, requirements and performance of the solar collector subassemblies/subsystems are discussed: mount and drives, reflector, receiver, and collector control unit. Problems experienced during collector testing in Albuquerque are identified and solutions described. J.M.S.

N80-24768*# General Electric Co., Philadelphia, Pa.
THE 1ST GENERATION LOW COST POINT FOCUS SOLAR CONCENTRATOR
J. Zimmerman *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 63-67 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

A point focus solar concentrator that, given a high volume of production, will optimize the ratio of performance to cost is considered. The concentrator design approach has evolved by a systematic process of examining the operating requirements particular to the solar application, minimizing material content through detail structural design and structurally efficient subsystem features, and utilizing materials and processes compatible with high volume production techniques. The design approach, the rationale for the configuration and subsystem selections, and the development status are described. J.M.S.

N80-24769*# Acurex Corp., Mountain View, Calif.
A CELLULAR GLASS SUBSTRATE SOLAR CONCENTRATOR
Roger Bedard and D. Bell *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 69-73 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

The design of a second generation point focusing solar concentration is discussed. The design is based on reflective gores fabricated of thin glass mirror bonded continuously to a contoured substrate of cellular glass. The concentrator aperture and structural stiffness was optimized for minimum concentrator cost given the performance requirement of delivering 58 kWth to a 22 cm diameter receiver aperture with a direct normal insolation of 845 watts sq m and an operating wind of 50 kmph. The reflective panel, support structure, drives, foundation and instrumentation and control subsystem designs, optimized for minimum cost, are summarized. The use of cellular glass as a reflective panel substrate material is shown to offer significant weight and cost advantages compared to existing technology materials. R.E.S.

N80-24770*# AiResearch Mfg. Co., Torrance, Calif.
THE DEVELOPMENT OF AN AIR BRAYTON AND A STEAM RANKINE SOLAR RECEIVER
Max V. Greeven *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 75-85 refs (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

An air Brayton and a steam Rankine solar receiver now under development are described. These cavity receivers accept concentrated insolation from a single point focus, parabolic concentrator, and use this energy to heat the working fluid. Both receivers were designed for a solar input of 85 kw. The air Brayton receiver heats the air to 816 C. A metallic plate-fin heat transfer surface is used in this unit to effect the energy transfer. The steam Rankine receiver was designed as a once-through boiler with reheat. The receiver heats the water to 704 C to produce steam at 17.22 MPa in the boiler section. The reheat section operates at 1.2 MPA, reheating the steam to 704 C. R.E.S.

N80-24771*# Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div.
AN ORGANIC RANKINE RECEIVER FOR THE SCSTPE PROGRAM
D. B. Osborn *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 87-93 refs (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

The organic Rankine cycle receiver which is presently being developed is described. The receiver employs an integrated cavity/pool boiler which permits the design of a small, lightweight, low cost and efficient moderate temperature receiver for use in a dish-Rankine solar thermal system. R.E.S.

N80-24772*# Fairchild Stratos Corp., Manhattan Beach, Calif.
NON-HEAT PIPE/P-40 STIRLING ENGINE
R. A. Haglund *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 95-97 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

The non-heat-pipe receiver/P-40 Stirling engine system design is described. A 25 kW direct-driven induction-type

alternator will be mounted directly to the P-40 engine to produce to a 60 Hz, 115/230 volt output. R.E.S.

N80-24773*# Ford Aerospace and Communications Corp., Newport Beach, Calif.
THE SCSTPE ORGANIC RANKINE ENGINE
Frank P. Boda *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 99-105 refs (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

The organic Rankine cycle engine under consideration for a solar thermal system being developed is described. Design parameters, method of control, performance and cost data are provided for engine power levels up to 80 kWe; efficiency is shown as a function of turbine inlet temperature in the range of 149 C to 427 C. R.E.S.

N80-24774*# AiResearch Mfg. Co., Phoenix, Ariz.
A HYBRID BRAYTON ENGINE CONCEPT
Lyle D. Six and R. Elkins *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 107-112 ref (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

A first generation open cycle Brayton engine concept for use in full scale solar module testing was defined. The concept extended to include solar/fossil hybrid capability. The combustion system defined for hybrid operation consists of a wide range combustor liner, a single airblast atomizer, an ignitor and a high-voltage ignition unit. Wide range combustor operation would be achieved through combining pilot and primary zones. The hybrid control mode and the solar only control mode are both based on the concept of maintaining constant turbine inlet temperature and varying the engine speed for part-power operation. In addition, the hybrid control concept will allow the operator to set a minimum thermal power input to the engine by setting a corresponding minimum engine speed. When the solar thermal power input falls below this minimum, fossil fuel would be utilized to augment the solar thermal power input. R.E.S.

N80-24775*# United Sterling, Inc. Alexandria, Va.
THE UNITED STIRLING P40 ENGINE FOR SOLAR DISH CONCENTRATOR APPLICATION
Lars Ortegren and Lars E. Sjoetedt (United Stirling A.B., Malmo, Sweden) *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 113-117 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

The United Stirling P40 engine is a key component in a solar concentration based energy conversion system, to be demonstrated and tested during 1980-81. The inherent characteristics of modern Stirling engines is reviewed focusing on the baseline P40 double-acting engine. The extent of modifications required for the solar application is reviewed and performance data are predicted. Finally, the potential of an advanced solar Stirling engine is briefly considered. R.E.S.

N80-24776*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
JPL'S PARABOLIC DISH TEST SITE
Terry L. Hagen *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 119-123 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

A parabolic dish test site (PDTS) was established in the California Mojave Desert to carry out work in testing solar point focusing concentrator systems and related hardware. The site was chosen because of its high solar insolation level and year around clear sky conditions. The various facilities and equipment at the PDTS, and the concentrator experiments being performed are described. R.E.S.

N80-24777*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OMNIUM-G CONCENTRATOR TEST RESULTS
Jack D. Patzold *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 125-131 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

A performance evaluation was conducted on a commercially available point-focus solar concentrator, the Heliodyne model HTC-25s tracker/concentrator. Thermal power test results indicate that slightly more than six kilowatts of thermal energy is available from a system of this configuration using a 10 cm aperture. R.E.S.

N80-24778*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE JPL FLUX MAPPER
William A. Owen *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 133-137 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

The flux mapper is a device that can map the intensity distribution in three dimensions of concentrated solar energy at the focus of a concentrator. Intensities to 10,000 solar constants can be measured. Constructed to assist in concentrator and receiver development, it consists of a radiometer which is moved through the concentrated sunlight in a series of planes perpendicular to the optical axis by means of a mechanical rastering device. Various radiometer probes can be utilized depending on the time and accuracy requirements of the program. Energy levels are recorded as a function of location. Reduction of this data can be in various formats, e.g., contour maps, digital arrays, isometric visualizations and other displays as the user requires. R.E.S.

N80-24779*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
COSTING THE OMNIUM-G SYSTEM 7500
H. R. Fortgang *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 139-144 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 05C

A complete OMNIUM-G System 7500 was cost analyzed for annual production quantities ranging from 25 to 10,000 units per year. Parts and components were subjected to in-depth scrutiny to determine optimum manufacturing processes, coupled with make or buy decisions on materials and small parts. When production quantities increase both labor and material costs reduce substantially. A redesign of the system that was analyzed could result in lower costs when annual production runs approach 100,000 units/year. Material and labor costs for producing 25, 100, 25,000 and 100,00 units are given for 17 subassembly units. A.R.H.

N80-24780*# Pioneer Engineering and Mfg. Co., Inc., Warren, Mich.
TBC COSTING
Henry L. Kaminski *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 145-152 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 05C

Procedures to be used in determining the cost of producing and installing a parabolic dish collector in annual production volumes of 10,000, 50,000, 100,000, and 1,000,000 units include (1) evaluating each individual part for material cost and for the type and number of operations required to work the raw material into the finished part; (2) costing labor, burden, tooling, gaging, machinery, and equipment; (3) estimating facilities requirements for each production volume; and (4) considering suggestions for design and material alterations that could result in cost reduction. A.R.H.

N80-24781*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
COST ESTIMATING BRAYTON AND STIRLING ENGINES
Herbert R. Fortgang *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 153-158 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 05C

Brayton and Stirling engines were analyzed for cost and selling price for production quantities ranging from 1000 to 400,000 units per year. Parts and components were subjected to indepth scrutiny to determine optimum manufacturing processes coupled with make or buy decisions on materials and small

parts. Tooling and capital equipment costs were estimated for each detail and/or assembly. For low annual production volumes, the Brayton engine appears to have a lower cost and selling price than the Stirling Engine. As annual production quantities increase, the Stirling becomes a lower cost engine than the Brayton. Both engines could benefit cost wise if changes were made in materials, design and manufacturing process as annual production quantities increase. Author

N80-24782*# Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div.
THE DISH-RANKINE SCSTPE PROGRAM (ENGINEERING EXPERIMENT NO. 1)
Robert L. Pons and Carl E. Grigsby *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 159-167 ref (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

Activities planned for phase 2 of the Small Community Solar Thermal Power Experiment (PFDR) program are summarized with emphasis on a dish-Rankine point focusing distributed receiver solar thermal electric system. Major design efforts include: (1) development of an advanced concept indirect-heated receiver;(2) development of hardware and software for a totally unmanned power plant control system; (3) implementation of a hybrid digital simulator which will validate plant operation prior to field testing; and (4) the acquisition of an efficient organic Rankine cycle power conversion unit. Preliminary performance analyses indicate that a mass-produced dish-Rankine PFDR system is potentially capable of producing electricity at a levelized busbar energy cost of 60 to 70 mills per KWh and with a capital cost of about $1300 per KW. A.R.H.

N80-24783*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SITING SOLAR THERMAL POWER EXPERIMENTS
Herbert J. Holbeck *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 169-173 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

The Small Community Solar Thermal Power Experiment will test a point-focusing, distributed receiver system in a small community, electric utility application. Site planning is becoming increasingly important for solar experiments as well as all kinds of development due to increased competition for desirable sites and increased complexity of regulatory requirements. Siting issues can be categorized as: (1) resources and physical environmental at this site; (2) acquisition, permits and regulations; and (3) development requirements and costs. These issues are addressed with respect to the unique requirements of solar thermal power experiments. A.R.H.

N80-24784*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE JPL ISOLATED APPLICATION EXPERIMENT SERIES
Richard R. Levin *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 175-179 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

A set of small (approximately 60-150 kWe) solar thermal power experiments, each of which is meant to address a separate isolated load application, will employ point focusing distributed receiver technology with emphasis on electric and possibly some thermal power applications. The program will be closely integrated with the technology development element of the thermal power systems project with the objective of utilizing the technologies being developed under that program. A.R.H.

N80-24785*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INDUSTRIAL APPLICATION EXPERIMENT SERIES
Steven A. Bluhm *In its* Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 181-184 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

The deployment of parabolic dish systems into the industrial sector for the purpose of providing users, suppliers, sponsors, and developers with a realistic assessment of system feasibility in selected near-term industrial applications will be accomplished initially through the industrial module experiment and later through additional experiments involving thermal, electric, and combined thermal and electrical systems. The approach is to progress through steps, from single module to multi-module systems, from thermal-only applications to more complex combined thermal and electric applications. The experience of other solar thermal experiments, particularly those involving parabolic dish hardware, will be utilized to the fullest extent possible in experiment planning and implementation. A.R.H.

N80-24786*# General Electric Co., Philadelphia, Pa.
SPS MARKET ANALYSIS
Hugh C. Goff *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 185-189 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 05C

A market analysis task included personal interviews by GE personnel and supplemental mail surveys to acquire statistical data and to identify and measure attitudes, reactions and intentions of prospective small solar thermal power systems (SPS) users. Over 500 firms were contacted, including three ownership classes of electric utilities, industrial firms in the top SIC codes for energy consumption, and design engineering firms. A market demand model was developed which utilizes the data base developed by personal interviews and surveys, and projected energy price and consumption data to perform sensitivity analyses and estimate potential markets for SPS. A.R.H.

N80-24787*# BDM Corp., McLean, Va.
MILITARY MARKETS FOR SOLAR THERMAL ELECTRIC POWER SYSTEMS
James S. Hauger *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 191-195 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

The Department of Defense maintains an inventory of over 1,800 MW of engine-generators 15 KW and larger, with an estimated procurement rate of over 140 MW/year. Nearly the entire requirement could be met by advanced heat engines of the types being developed as point-focussing, distributed receiver power plants. A conceptual system consisting of a heat engine which efficiently burns liquid fossil or synthetic fuels, with a 'solarization kit' for conversion to hybrid solar operation could meet existing DOD requirements for new systems which are quieter, lighter, and multi-fueled. An estimated 24 percent (33 MW/year) or more could operationally benefit from the solar option. Baseline cost projections indicate levelized energy cost goals of 210 to 120 mills/KWh (15 to 1000 KW systems). Fuel cost escalation is the major factor affecting the value of the solar option. A baseline calculation for fuel at $0.59/gal in spring, 1979, escalating at 8 percent above general inflation indicates a value of $2700/KWe for a solarization kit. A.R.H.

N80-24788*# Science Applications, Inc., McLean, Va.
SOLAR THERMAL PLANT IMPACT ANALYSIS AND REQUIREMENTS DEFINITION
Yudi P. Gupta *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 197-209 (For primary document see N80-24760 15-44)
(Contract JPL-955238)
Avail: NTIS HC A11/MF A01 CSCL 10B

Progress on a continuing study comprising of ten tasks directed at defining impact and requirements for solar thermal power systems (SPS), 1 to 10 MWe each in capacity, installed during 1985 through year 2000 in a utility or a nonutility load in the United States is summarized. The point focus distributed receiver (PFDR) solar power systems are emphasized. Tasks 1 through 4, completed to date, include the development of a comprehensive data base on SPS configurations, their performance, cost, availability, and potential applications; user loads, regional characteristics, and an analytic methodology that incorporates the generally accepted utility financial planning methods and several unique modifications to treat the significant and specific characteristics of solar power systems deployed in either central or distributed power generation modes, are discussed. E.D.K.

N80-24789*# Little (Arthur D.), Inc., San Francisco, Calif.
A STUDY OF MASS PRODUCTION AND INSTALLATION OF SMALL SOLAR THERMAL ELECTRIC POWER SYSTEMS
John F. Butterfield *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 211-215 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

Technological constraints, materials availability, production capacity, and manufacturing and installations plans and costs at different production levels are included in a study of concentrating collector industrialization. As cobalt for the engine and receiver is supply limited, alternative lower temperature alloys and higher temperature materials such as ceramics are discussed. Economics and production efficiency favor co-location of cellular and thin glass production for reflectors. Assembly and installation are expensive for small sites and few alternatives exist to apply mass production techniques to lower these costs for the selected design. Stepping motors in the size and quantities required are not commercially available today but could be in the future.
E.D.K.

N80-24790*# Texas Technological Univ., Lubbock. Dept. of Electrical Engineering.
THE CROSSBYTON PROJECT
John D. Reichert *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 217-220 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

The Analog Design Verification System (ADVS), the largest single solar collector built, was tested. Referred to as the Solar Gridiron or Bowl Concept, it employs a stationary mirror, with tracking accomplished by the mirror.
E.D.K.

N80-24791*# Acurex Corp., Mountain View, Calif.
IEA/SPS 500 kW DISTRIBUTED COLLECTOR SYSTEM
Temple W. Neumann and Creighton D. Hartman *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 221-227 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

Engineering studies for an International Energy Agency project for the design and construction of a 500 kW solar thermal electric power generation system of the distributed collector system (DCS) type are reviewed. The DCS system design consists of a mixed field of parabolic trough type solar collectors which are used to heat a thermal heat transfer oil. Heated oil is delivered to a thermocline storage tank from which heat is extracted and delivered to a boiler by a second heat transfer loop using the same heat transfer oil. Steam is generated in the boiler, expanded through a steam turbine, and recirculated through a condenser system cooled by a wet cooling tower.
E.D.K.

N80-24792*# Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
COOLIDGE SOLAR POWERED IRRIGATION PUMPING PROJECT
Dennis L. Larson *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 229-233 refs (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

A 150 kW solar thermal electric power plant which includes over 2100 square meters of parabolic trough type collectors and an organic Rankine cycle turbine engine was constructed on an irrigated farm. The plant is interconnected with the electrical utility grid. Operation is providing an evaluation of equipment performance and operating and maintenance requirements as well as the desirability of an on farm location.
E.D.K.

N80-24793*# Battelle Columbus Labs., Ohio.
THE 50-HORSEPOWER SOLAR-POWERED IRRIGATION FACILITY LOCATED NEAR GILA BEND, ARIZONA
Wilbur A. Smith, G. Alexander, and D. F. Busch *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 235-239 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

The 50 horsepower solar powered irrigation facility near Gila Bend, Arizona which includes a Rankine cycle demonstrates the technical feasibility of solar powered pumping. The design of a facility specifically for the irrigation farmer using the technology that has been developed over the last four years is proposed.
E.D.K.

N80-24794*# New Mexico State Univ., Las Cruces.
PRELIMINARY OPERATIONAL RESULTS FROM THE WILLARD SOLAR POWER SYSTEM
Donald L. Fenton, G. H. Abernathy, G. Krivokapich, D. E. Ellibee, and V. Chilton *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 241-248 refs (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10B

The solar powered system located near Willard, New Mexico, generates mechanical or electrical power at a capacity of 19 kW (25 HP). The solar collection system incorporates east/west tracking parabolic trough collectors with a total aperture area of 1275 sq m (13,720 sq ft). The hot oil type thermal energy storage is sufficient for approximately 20 hours of power system operation. The system utilizes a reaction type turbine in conjunction with an organic Rankine cycle engine. Total collector field efficiency reaches a maximum of 20 percent near the winter solstice and about 50 percent during the summer. During the month of July, 1979, the system pumped 60 percent of the 35,300 cu m (28.6 acre-feet) of water delivered. Operating efficiencies for the turbine component, organic Rankine cycle engine and the complete power system are respectively 65 to 75 percent, 12 to 15 percent and 5 to 6 percent. Significant maintenance time was expended on both the collector and power systems throughout the operational period.
Author

N80-24795*# Georgia Power Co., Atlanta.
SOLAR TOTAL ENERGY-LARGE SCALE EXPERIMENT, SHENANDOAH, GEORGIA
Walter R. Hensley *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 247-249 (For primary document see N80-24760 15-44)
Avail: NTIS HC A11/MF A01 CSCL 10A

The design and development of a 7 meter diameter parabolic dish solar collector are discussed. Each of the four main subsystems of the collector: (1) reflector, (2) mount and drives, (3) receiver and (4) the controls, is discussed briefly with the major emphasis on the receiver design. To minimize development risks and production costs, a dish design based on use of stamped aluminum petals (sectors) was chosen. This design is similar to the design of a communication antenna already commercially produced. The reflective surface of the petals has a total reflectance of .86 and a specularity (dispersion) of 8 mrd. This performance is obtained by mechanical polishing and chemical brightening of the petal surface, followed by application of a clear RTV silicone protective coating. Selection of the material and weather proofing coated are discussed. Results from performance tests on an engineering development dish collector are presented and compared with pretest predictions.
J.M.S.

N80-24796*# General Electric Co., Philadelphia, Pa.
SOLAR TOTAL ENERGY PROJECT AT SHENANDOAH, GEORGIA SYSTEM DESIGN
A. J. Poche *In* JPL Proc. of the First Semiann. Distributed Receiver Program Rev. 15 May 1980 p 251-255 (For primary document see N80-24760 15-44)
(Contracts EG-77-C-04-3985; DE-AC04-77ET-20260)
Avail: NTIS HC A11/MF A01 CSCL 10B

The solar total energy system (STES) was to provide 50% of the total electrical and thermal energy requirements of the 25,000 sq ft Bleyle of America knitwear plant located at the Shenandoah Site. The system will provide 400 kilowatts electrical and 3 megawatts of thermal energy. The STES has a classical, cascaded total energy system configuration. It utilizes one hundred twenty (120), parabolic dish collectors, high temperature (750 F) trickle oil thermal energy storage and a steam turbine generator. The electrical load shaving system was designed for interconnected operation with the Georgia Power system and for operation in a stand alone mode.
J.M.S.

N80-24797*# General Electric Co., Schenectady, N. Y. Energy Technology Operation.
COGENERATION TECHNOLOGY ALTERNATIVES STUDY (CTAS). VOLUME 1: SUMMARY REPORT Final Report

H. E. Gerlaugh, E. W. Hall, D. H. Brown, R. R. Priestley, and W. F. Knightly Jan. 1980 154 p
(Contract DEN3-31)
(NASA-CR-159765; GE79ET0102; DOE/NASA/0031-80/1) Avail: NTIS HC A08/MF A01 CSCL 10B

Large savings can be made in industry by cogenerating electric power and process heat in single energy conversion systems rather than separately in utility plants and in process boilers. About fifty industrial processes from the largest energy consuming sectors were used as a basis for matching a similar number of energy conversion systems that are considered as candidates which can be made available by the 1985 to 2000 time period. The sectors considered included food, textiles, lumber, paper, chemicals, petroleum, glass, and primary metals. The energy conversion systems included steam and gas turbines, diesels, thermionics, stirling, closed-cycle and steam injected gas turbines, and fuel cells. Fuels considered were coal, both coal and petroleum-based residual and distillate liquid fuels, and low Btu gas obtained through the on-site gasification of coal. An attempt was made to use consistent assumptions and a consistent set of ground rules for determining performance and cost in individual plants and on a national level. It was found that: (1) atmospheric and pressurized fluidized bed steam turbine systems were the most attractive of the direct coal-fired systems; and (2) open-cycle gas turbines with heat recovery steam generators and combined-cycles with NO(x) emission reduction and moderately increased firing temperatures were the most attractive of the coal-derived liquid-fired systems. R.E.S.

N80-24798*# Rockwell International Corp., Huntsville, Ala.
STUDY OF MULTI-kW SOLAR ARRAYS FOR EARTH ORBIT APPLICATIONS: MIDTERM PERFORMANCE REVIEW
26 Jul. 1979 98 p
(Contract NAS8-32988)
(NASA-CR-161467) Avail: NTIS HC A05/MF A01 CSCL 10A

Planar and concentrator solar array concepts capable of providing 300 kW to 1000 kW in low Earth orbit applications in the 1987 time period at an array recurring cost less than or equal to thirty dollars per watt are examined. Silicon and gallium arsenide solar cell applicability are evaluated. On-orbit maintenance by space shuttle is also investigated. Design configurations for the solar arrays and solar cells are recommended. R.E.S.

N80-24799# Naval Weapons Center, China Lake, Calif.
GEOTHERMAL ENERGY RESOURCES OF NAVY/MARINE CORPS INSTALLATIONS ON THE ATLANTIC AND GULF COASTAL PLAIN Interim Report, Jun. - Sep. 1978
Douglas W. Edsall (Naval Academy) Mar. 1980 43 p refs
(AD-A082400; NWC-TP-6062) Avail: NTIS HC A03/MF A01 CSCL 10/1

The search for alternative energy sources is of great importance to the U.S. Navy. Preliminary examination of data from the literature, bottom hole temperatures from existing deep wells, and heat flow measurements in wells drilled at selected sites as part of a current research program sponsored by the Department of Energy have demonstrated that low temperature waters (-212 F or 100 C) may be available at moderate depths in the major sedimentary basins along the Atlantic and east Gulf Coastal Plain. Although the possible geothermal energy resources present here are not sufficient for electrical power generation, they appear adequate for space heating and cooling. The Navy should take a leading role in planning and executing exploratory drilling and resource evaluation programs, especially at the following installations, all of which are major energy users: Norfolk, Portsmouth, and Virginia Beach, Virginia; Charleston, South Carolina; and Pensacola, Milton, and Panama City, Florida. GRA

N80-24800# EIC, Inc., Newton, Mass.
INVESTIGATIONS OF THE SAFETY OF Li/SOCl2 BATTERIES Final Report, 30 Sep. 1978 - 29 Sep. 1979
Kuzhikalail M. Abraham, Richard M. Mank, and Gerhard L. Holleck Fort Monmouth, N. J. Army Electronics Research and Development Command Feb. 1980 105 p refs
(Contract DAAB07-78-C-0584; DA Proj. 1L1-62705-AH-94)
(AD-A081998; C-536; DELET-TR-78-0564-F) Avail: NTIS HC A06/MF A01 CSCL 10/3

Forced overdischarge behavior of Li/SOCl2 cells was studied using spirally wound C-size and small prismatic cells. Cathode and anode limited cells were tested. Cathode limited cells could be forcibly overdischarged for long periods of time without explosions. Anode limited cells, on the other hand, were found to be potentially hazardous. Our data suggest that anode limited cells are likely to explode during forced overdischarge. The behavior of Li/SOCl2 cells during application of a (charge) current was investigated using C-size cells. It was possible to subject either new or partially discharged cells to a (charging) current without apparent hazard. The charging reactions involve a sequence of regenerative processes so that only small amounts of chemicals accumulate in the cells. On the basis of materials characterized from IR spectral and cyclic voltammetry data, a mechanism is proposed for the oxidation reactions in SOCl2/LiAlCl4 solutions. Preliminary studies indicated that Li2S/AlCl3 based electrolytes may be useful as alternatives to LiAlCl4 in Li/SOCl2 batteries. GRA

N80-24801# Brookhaven National Lab., Upton, N. Y.
LOW-COST GENERAL ENERGY/ANALYTIC INFORMATION SYSTEM
Ann W. Reisman and Jack Allentuck 1979 7 p Presented at the Intern. Conf. on Energy Use Management, Los Angeles, 22 Oct. 1979
(Contract EY-76-C-02-0016)
(BNL-26398; CONF-791009-6) Avail: NTIS HC A02/MF A01

Energy planning is frequently complicated by the fact that many countries should not be viewed as single entities, but rather as assemblies of regions. Sub-national regional differences arise from variations in terrain and climate, and demographic and historical patterns as well as combinations of these and other factors. Planners must consider sub-national regional needs and opportunities in formulating national energy plans. The structure and data requirements for a low cost energy/analytic information system having a regional capability is outlined. The kinds of planning decisions that require energy-information-system support are examined. The information content of an energy information system is summarized and its basic analytic capabilities are described. DOE

N80-24802# Logistics Management Inst., Washington, D. C.
THE PROJECT INDEPENDENCE EVALUATION SYSTEM (PIES). VOLUME 1: DESCRIPTION OF THE SYSTEM, EXECUTIVE SUMMARY
Oct. 1978 51 p
(Contract EA-78-X-01-1321)
(HCP/I-1321-01/1) Avail: NTIS HC A04/MF A01

The project independence evaluation system (PIES) a national energy forecasting system used to provide baseline forecasts of energy prices, supplies, demand, and conversion activities is described. It is an analytical tool that can be used to examine the potential impact of changes in Federal policies by the specification of alternate scenarios. An overview which described the main features of the PIES; a discussion of the regional representation within the system; descriptions of the major supply and conversion submodels; a description of available documentation; and appendices that describe the modeling of refineries and utilities are provided. DOE

N80-24803# Sandia Labs., Albuquerque, N. Mex.
BATTERIES FOR SPECIFIC SOLAR APPLICATIONS: PROJECT DESCRIPTION
1979 47 p Presented at the Photovoltaic/Battery Storage Meeting, Albuquerque, N. Mex., 26-27 Jul. 1979
(Contract EY-76-C-04-0789)
(SAND-79-1782C; CONF-790788-1) Avail: NTIS HC A03/MF A01

The Sandia Laboratories electrochemical power sources program is outlined. The project is divided into five tasks: (1) battery requirements analysis; (2) laboratory evaluation; (3) photovoltaic advanced systems tests; (4) photovoltaic application experiments; and (5) battery research and development. The status of each task is reviewed. DOE

N80-24804# Argonne National Lab., Ill.
INSTITUTIONAL TOTAL ENERGY CASE STUDIES

D. Wullinghoff Jul. 1979 51 p
(Contract W-31-109-eng-38)
(ANL/CNSV-TM-15) Avail: NTIS HC A04/MF A01

Profiles of three total energy systems in institutional settings are presented. The plants are those of Franciscan Hospital, a 384 bed facility in Rock Island, Illinois; Franklin Foundation Hospital, a 100 bed hospital in Franklin, Louisiana; and the North American Air Defense Command Cheyenne Mountain Complex, a military installation near Colorado Springs, Colorado. The case studies include descriptions of plant components and configurations, operation and maintenance procedures, reliability, relationships to public utilities, staffing, economic efficiency, and factors contributing to success. DOE

N80-24805# Midwest Research Inst., Kansas City, Mo.
SOLAR REFLECTANCE, TRANSMITTANCE AND ABSORPTANCE OF COMMON MATERIALS
B. C. Butler, P. J. Call, G. L. Jorgensen, and R. B. Pettit (Sandia Labs., Albuquerque, N.M.) Oct. 1979 8 p refs Presented at the Solar Industrial Process Heat Conf., San Francisco, 31 Oct. 1979
(Contract EG-77-C-01-4042)
(SERI/TP-334-457; CONF-791024-9) Avail: NTIS HC A02/MF A01

The solar reflectance, transmittance, and absorptance of common materials used for solar collector fabrication were compiled for easy reference. The data are derived from solar weighted averaging techniques and can be used for initial calculations of collector performance. DOE

N80-24806# California Univ., Livermore. Lawrence Livermore Lab.
STATUS OF TANDEM MIRROR THEORY
D. E. Baldwin 12 Dec. 1979 45 p Proceedings of 21st Ann. Meeting of the Am. Phys. Soc., Boston, 12-16 Nov. 1979
(Contract W-7405-eng-48)
(UCRL-83213; CONF-791135-4) Avail: NTIS HC A03/MF A01

The text and slides used for the review talk on tandem mirror theory presented at the meeting of the Division of Plasma Physics, A.P.S., Boston, MA, November 12-16, 1979 are included. Topics covered include classical confinement, equilibria, MHD- and micro-stability, radial transport, and thermal barriers. DOE

N80-24807# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
RESIDENTIAL SOLAR HEATING AND COOLING USING EVACUATED TUBE SOLAR COLLECTORS: CSU SOLAR HOUSE 3 Final Report, Management Summary, 1 Feb. 1976 - 30 Sep. 1978
Dan S. Ward, John C. Ward, and H. S. Oberoi Mar. 1979 11 p
(Contract EY-76-S-02-2858)
(COO-2858-24-Summ) Avail: NTIS HC A02/MF A01

An integrated evacuated tube solar collector and absorption space cooling system installed in a solar house was designed, tested, and evaluated. The seasonal performance was compared with two other solar heating and cooling systems installed in adjacent buildings with virtually identical thermal characteristics. The two comparison system consist of conventional solar water heating and air heating flat plate collectors. DOE

N80-24808# Badger Plants, Inc., Cambridge, Mass.
CONCEPTUAL DESIGN OF A COAL-TO-METHANOL-TO-GASOLINE COMMERCIAL PLANT. VOLUME 5: ALTERNATE DESIGN STUDIES Interim Final Report, 31 Aug. 1977 - 1 Mar. 1979
Mar. 1979 209 p
(Contract EX-76-C-01-2416)
(FE-2416-43-Vol-5; IFR-2) Avail: NTIS HC A10/MF A01

Three design cases were investigated for converting methanol to gasoline using the Mobil process. These are defined as Case A, which produces gasoline and byproduct Liquid Propane Gas (LPG); Case B, which produces gasoline, high Btu gas, and byproduct LPG; and Case C, which produces gasoline only. The LPG includes propane LPG and high purity isobutane. Alternate Cases A and C are described. Additional process studies, including economy of scale evaluations, studies of Lurgi methanol synthesis recommendations, integration of Methanol-to-Gasoline facilities with a refinery, and recovery of aromatics from stabilized synthetic gasoline, are discussed. DOE

N80-24809# Galaxy, Inc., Washington, D.C.
ORGANIC RANKINE CYCLE ENGINE TECHNOLOGY IN JAPAN, A PRELIMINARY SURVEY
Oct. 1979 132 p refs
(Contract DE-AC03-79SF-10538)
(DOE/SF/10538-1) Avail: NTIS HC A07/MF A01

The state-of-the-art of the development of organic Rankine cycle engines in Japan is reviewed. With the first oil crisis as a momentum, general volition to research and development and commercialization efforts of the Rankine cycle has rapidly developed. However, practical applications by industries will be the matter of future. Recovery systems of waste heat should be designed based on availability of waste heat sources. The Rankine cycle, as one of the electric power generators, has a wider range of application and thus, especially in Japan, the development of Rankine cycle technology is going forward. Although the presently attained thermal utilization rate is only 20%, future improvement of the rate will be considerably dependent on the contribution of the developments on specific various units, for example, the heat exchanger. R.E.S.

N80-24810# Battelle Pacific Northwest Labs., Richland, Wash.
COMPRESSED AIR ENERGY STORAGE TECHNOLOGY PROGRAM IN THE UNITED STATES
W. V. Loscutoff 1979 8 p Presented at the Intern. Assembly on Energy Storage, Dubrovnik, Yugoslavia, 26 May - 1 Jun. 1979
(Contract EY-76-C-06-1830)
(PNL-SA-7669; CONF-790515-6) Avail: NTIS HC A02/MF A01

The development of compressed air energy storage (CAES) technology is a recognized objective of the United States Department of Energy. The specific objectives are to develop the technology to a level that will permit early commercialization of the concept and to develop advanced CAES systems that will not require any petroleum fuels for operation. The CAES technology research and development program is summarized and a brief set of recommendations on the developments required for the commercialization of the concept is provided. DOE

N80-24811# Dayton Univ. Research Inst., Ohio.
ELECTROFLUID DYNAMIC WIND GENERATOR Final Annual Progress Report, 15 Sep. 1977 - 30 Sep. 1978
John E. Minardi, Maurice O. Lawson, and Frank L. Wattendorf May 1979 76 p refs
(Contract EY-76-S-02-4130)
(COO-4130-2; APR-3) Avail: NTIS HC A05/MF A01

The objective of the program is to conduct research leading to the development of EFD wind driven generators. In such generators, the wind blows through suitably oriented arrays of electrodes, transports charged particles against an electrical potential gradient, and thereby generates electrical power directly without moving parts. Significant progress has been made in accomplishing major research objectives. During the year, the effort was directed toward the achievement of three milestones; namely: development of a laboratory method for the production of an adequate supply of suitably low mobility charged droplets for the testing of generator performance; experimental verification of generator performance theory; and development of methods for practical production of charged droplets. DOE

N80-24812*# Rasor Associates, Inc., Sunnyvale, Calif.
ADVANCED THERMIONIC ENERGY CONVERSION Joint Highlights and Status Report, Apr. - Jun. 1979
1979 81 p refs
(Contracts JPL-955033; EY-76-C-02-2263)
(NASA-CR-163061; COO-2263-15; NSR-2-15) Avail: NTIS CSCL 10A

Developments towards space and terrestrial applications of thermionic energy conversion are presented. Significant accomplishments for the three month period include: (1) devised a blade-type distributed lead design with many advantages compared to the stud-type distributed lead; (2) completed design of Marchuk tube test apparatus; (3) concluded, based on current understanding, that residual hydrogen should not contribute to a

negative space charge barrier at the collector; (4) modified THX design program to include series-coupled designs as well as inductively-coupled designs; (5) initiated work on the heat transfer technology, THX test module, output power transfer system, heat transfer system, and conceptual plant design tasks; and (6) reached 2200 hours of operation in JPL-5 cylindrical converter envelope test. DOE

N80-24813# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.

HEAT-PUMP-CENTERED INTEGRATED COMMUNITY ENERGY SYSTEMS Final Report

Nov. 1979 214 p refs Supersedes ANL/ICES-TM-31 Prepared for Argonne National Lab., Ill.

(Contract W-31-109-eng-38)

(ANL/CNSV-TM-18; ANL/ICES-TM-31) Avail: NTIS HC A10/MF A01

A Heat Pump Centered-Integrated Community Energy System (HP-ICES) concept was explored and developed that is based on use of privately owned ice-making heat pumps in each building or complex within a community. These heat pumps will provide all of the space heating, space cooling and domestic hot water needs. All of the community input energy required is provided by electrical power, thereby eliminating a community's dependence on gas or oil supplies. The heat pumps will operate in both air and water source modes, deriving performance advantages of both. The possible forms of an HP-ICES system, the technical and economic limitations, environmental impacts and other factors are discussed from a general viewpoint. The concept is applied to a specific planned community and its performance and economic features are examined in detail. It is concluded that the HP-ICES concept is technically viable, but that its economical desirability as compared with conventional heat pump systems is hampered by much higher initial costs, and that the economic feasibility of HP-ICES systems will depend on future fuel source costs and supply and on electric power rates. DOE

N80-24814# General Accounting Office, Washington, D. C.

FEDERAL GOVERNMENT NEEDS A COMPREHENSIVE PROGRAM TO CURB ITS ENERGY USE

E. B. Staats 12 Dec. 1979 66 p refs

(EMD-80-11) Avail: NTIS HC A04/MF A01

According to this GAO analysis, the Federal Government is not making a sufficient commitment to curbing its energy use. Its program to conserve energy is in disarray. Although the Congress and the President have enacted and issued legislative and executive guidance, a comprehensive and aggressive energy conservation program for the Federal sector has not been developed. The Department of Energy's efforts have been minimal and Federal agencies have resisted Energy's attempts to establish a meaningful program. The Federal Government - the Nation's largest consumer of energy needs a comprehensive, centrally directed program to curb energy use. Recommendations to the Congress, The President, and the Department of Energy to establish such a program are presented. DOE

N80-24815# Ames Lab., Iowa.

PRELIMINARY STUDY OF PASSIVE SOLAR HEATING PERFORMANCE AND VISUAL CLARITY FOR A TRANS-WALL STRUCTURE

J. F. McClelland and R. Fuchs 1979 7 p refs Presented at the 3rd Natl. Passive Solar Conf., San Jose, Calif., 11 Jan. 1979

(Contract W-7405-eng-82)

(ISM-206; CONF-790118-7) Avail: NTIS HC A02/MF A01

The thermal performance of a new passive solar heating system called Transwall has been compared to that of Trombe wall and direct gain systems using thermal network models. The Transwall system is a visually transparent modular water wall which thermalizes a high percentage of incident solar radiation within a water based storage medium by absorption of the radiation in both the water and in a semitransparent plate positioned between the light transmitting walls of the water filled modules. The Transwall structure allows vision to the exterior through the solar gain fenestration and provides a direct gain contribution to the building heating requirements. Because of the strong light attenuation by the Transwall, the direct gain operation of the system does not suffer from severe glare and photodegradation problems which occur in some direct gain interiors. DOE

N80-24816# California Univ., Berkeley. Lawrence Berkeley Lab.

SENSIBLE HEAT STORAGE FOR A SOLAR THERMAL POWER PLANT M.S. Thesis

Thomas F. Baldwin, Scott Lynn, and Alan S. Foss Jul. 1979 195 p refs

(Contract W-7405-eng-48)

(LBL-9321) Avail: NTIS HC A09/MF A01

One possible configuration for a solar power plant with a sensible-heat storage unit was investigated. The proposed flowsheet allows thermal energy storage between the heat collection unit and the power generation unit without a reduction in the thermodynamic availability of the energy supplied to the power turbines. Energy is stored by heating a checkerwork of magnesia bricks. A gas that is circulated from the solar collector through the storage unit and the power plant boiler serves as the heat-transfer medium. Nitrogen was found to be preferable to helium for this purpose. A computer model was used to predict the behavior of the sensible-heat storage unit and to aid in sizing the storage unit. Procedures were developed to estimate the cost of electricity generated by the solar power plant. The effects on the storage unit and on the total plant design of changing several processes and design parameters were then evaluated. Two alternative process configurations for solar power plants with sensible-heat storage were developed. DOE

N80-24817# Aerospace Corp., Los Angeles, Calif. Energy and Resources Div.

SOLAR THERMAL SMALL POWER SYSTEMS STUDY. INVENTORY OF US INDUSTRIAL SMALL ELECTRIC POWER GENERATING SYSTEMS

1 Jun. 1979 59 p ref

(Contract ET-78-C-03-2226)

(ATR-79(7780)-1) Avail: NTIS HC A04/MF A01

This inventory of small industrial electric generating systems was assembled to provide a data base for analyses being conducted to estimate the potential for displacement of these fossil fueled systems by solar thermal electric systems no larger than 10 MW in rated capacity. The approximately 2100 megawatts generating capacity of systems in this category constitutes a potential market for small solar thermal and other solar electric power systems. The sources of data for this inventory were the (former) Federal Power Commission (FPC) Form 4 Industrial Ledger and Form 12-C Ledger for 1976. Alphabetical lists are presented of generating systems located at industrial plants and at Federal government installations in each of the 50 states. These systems are differentiated by type of power plant: steam turbine, diesel generator, or gas turbine. Each listing is designed as a power system rather than a power unit because the GPC Ledgers do not provide a means of determining whether more than one unit is associated with each industrial installation. The user should consider each listing to be a system capacity rating wherein the system may consist of one or more generating units with less than 10 MW/sub e/ combined rating. DOE

N80-24818# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.

COMPOSITION PROFILING OF SOLAR COATING MATERIALS Final Report, 16 Apr. 1978 - 15 Apr. 1979

G. K. Wehner Sep. 1979 39 p refs

(Contract EY-76-S-02-2953)

(COO-2953-4) Avail: NTIS HC A03/MF A01

Auger electron composition vs. depth and optical analysis revealed that a very inexpensive-to-produce (15 min. 900 C heat treatment in air) Cr_2O_3 layer on stainless steels provides an excellent diffusion barrier for preventing stainless steel constituents from entering into an IR reflective Mo coating. It was shown that with sputter deposition of Mo at high rate in a clean noble gas plasma, one can obtain Mo coatings of excellent IR reflectance. The optical properties of various other absorber surfaces such as stacked razor blades, cone or whisker-covered metal surfaces, plasma-sprayed chromic oxide coatings etc. were measured and explored. DOE

N80-24819# California Univ., Berkeley. Lawrence Berkeley Lab. Materials Science and Mineral Engineering.
CHEMICAL, STRUCTURAL AND OPTICAL CHARACTERIZATION OF A BLACK CHROME SOLAR SELECTIVE ABSORBER Ph.D. Thesis
C. M. Lampert Jul. 1979 173 p refs
(Contract W-7405-eng-48)
(LBL-9123) Avail: NTIS HC A08/MF A01

The very popular black chrome coating, Harshaw Chemical's Chromonyx was analyzed in terms of materials science to determine the nature of its microstructure and relationship to wavelength selectivity. This coating serves as an efficient solar thermal conversion coating for both concentrating and flat plate solar collectors. General properties of solar energy and selective absorbers are discussed to give a firm footing for analysis. Also, the properties and degradation modes were revealed for samples heat treated at high temperatures for short times. Several electrodeposited black chrome-substrate combinations were investigated including the favored black chrome with a dull nickel underlayer. It was found that black chrome coating thickness and surface roughness greatly influence spectral hemispherical reflectance. To a minor extent, underlayer material also altered infrared reflectance; nickel, copper and steel were evaluated. Principally, energy dispersive X-ray analysis as well as scanning and transmission electron microscopy were employed for thin film analysis. DOE

N80-24820# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
MEAN MONTHLY PERFORMANCE OF PASSIVE SOLAR WATER HEATERS
W. Place, M. Daneshyar (Univ. of Technology, Esfahan, Iran), and R. Kammerud Oct. 1979 8 p ref Presented at the 4th Natl. Passive Solar Energy Conf., Kansas City, Kas., 3 Oct. 1979
(Contract W-7405-eng-48)
(LBL-9295; CONF-791022-11) Avail: NTIS HC A02/MF A01

A simplified analysis was used to compare the average monthly performance of a compact heater (having combined collection and storage) and a thermosiphon heater (using natural convective transfer from a collector to an insulated tank). The comparison which was made for a range of climates and a variety of load profiles indicates that the performance of the thermosiphon is substantially superior to that of the compact heater. DOE

N80-24821# Springborn Labs., Inc., Enfield, Conn.
SOLAR COLLECTORS Technical Progress Report, 5 Sep. 1978 - 5 Mar. 1979
B. Baum and Michael Gage 27 Apr. 1979 54 p
(Contract EM-78-C-04-5359)
(ALO-5359-T1; TPR-1) Avail: NTIS HC A04/MF A01

A broad information search was carried out in four areas: glazings, housing materials, acrylic coatings, etching processes and AR coatings. An extensive list of all (known) US transparent polymers was developed as well as tables of plastic, ceramic and metallic materials that could conceivably function as a housing. In addition, a compilation was made of commercially available solvent and water base acrylic coatings for use as a uv protective coating for the glazing. Eighteen transparent polymers were chosen as possible glazings and twelve materials (plastic and wood) as possible housings and exposed in the Weather-Ometer as tensile bars and for the glazings as disks for optical transmission. These same materials were also exposed on our roof to monitor soiling. A variety of solvent and water base acrylics were selected as protective coatings and ordered. Two commercial films, Tedlar 20 and Halar 500, with strong absorption in the uv and two commercial films containing uv absorbers, Tedlar UT and Korad 201R, were laminated by several different processes to four promising glazing materials: polyvinyl fluoride (Tedlar), polymethyl methacrylate (Plexiglass), crosslinked ethylene/vinyl acetate and thermoplastic polyester (Llumar). A variety of etching processes were briefly explored and AR coating studies started on the above four glazing films. DOE

N80-24822# Rocket Research Corp., Redmond, Wash. System Development.
HEAT-PUMP-CENTERED INTEGRATED COMMUNITY ENERGY SYSTEMS Final Report
Nov. 1979 69 p refs
(Contract W-31-109-eng-38)
(ANL/CNSV-TM-20) Avail: NTIS HC A04/MF A01

Heat-pump-centered integrated community energy systems (HP-ICES) are energy systems for communities which provide heating, cooling and/or other thermal energy services through the use of heat pumps. Since heat pumps primarily transfer energy from existing and otherwise probably unused sources, rather than convert it from electrical or chemical to thermal form, HP-ICES offer significant potential for energy savings. Secondary benefits of HP-ICES include reduction of adverse environmental effects as compared to conventional systems, reliable production of services in contrast to the increasingly frequent utility curtailments and interruptions, and delivery of services to consumers at costs lower than those for conventional systems (including acquisition, operation, and maintenance costs). The objective of this multiphase project is development and demonstration of HP-ICES concepts leading to one or more operational systems by the end of 1984. The results of the system development phase of the HP-ICES Project are reported. Information is presented on: central heat pump and distributed heat pump ICES; potential application; waste heat availability; system performance and economics; environmental impacts; site requirements; component testing requirements; mathematical analysis of heat balance and cost relations; and performance and economic analyses of HP-ICES located near Seattle, Washington and San Antonio, Texas. DOE

N80-24823# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
HETEROSTRUCTURE SINGLE CRYSTAL SILICON PHOTOVOLTAIC SOLAR CELLS Final Report, 27 Sep. 1976 - 31 Jul. 1979
J. R. Szedon, T. A. Temofonte, T. W. OKeeffe, H. C. Dickey, S. J. Fonash, and T. E. Sullivan 31 Jul. 1979 209 p refs Prepared in cooperation with Pennsylvania State Univ., Univ. Park
(Contract EY-76-C-03-1282)
(DOE/ET/20408-1) Avail: NTIS HC A10/MF A01

Technical and commercial practicability (specifically, conversion efficiency of 10 percent or greater at a module selling price below $0.50/peak watt in 1975 dollars) for power generation of metal-heterojunction silicon solar cell of the metal-insulator semiconductor (MIS) variety is assessed. Empirical and theoretical studies were made of cells using both single crystal (n- and p-type) and polycrystalline (p-type) silicon with a variety of metals (Al, Au, Ag, Pd) and silicon dioxide lasers of various thicknesses. Performance limitations were identified. Means to improve cell performance were evaluated, including material modifications, layer thickness control and changes in device structure. It is concluded that the program goals can be met. Encouraging results in analysis of cells made with polycrystalline material provide a good basis for proceeding with future work to assess the prospects of even lower cost cells. DOE

N80-24824# Midwest Research Inst., Golden, Colo. Thermal Conversion Branch.
FEASIBILITY EVALUATION FOR SOLAR INDUSTRIAL PROCESS HEAT APPLICATIONS
S. A. Stadjuhar Jan. 1980 7 p refs Presented at the Systems Simulation and Econ. Analysis Conf., San Diego, Calif., 23 Jan. 1980
(Contract EG-77-C-01-4042)
(SERI/TP-333-538; CONF-800101-3) Avail: NTIS HC A02/MF A01

An analytical method for assessing the feasibility of Solar Industrial Process Heat applications was developed and implemented in a flexible, fast-calculating computer code, PROSYS/ECONMAT. The performance model PROSYS predicts long-term annual energy output for several collector types, including flat-plate, nontracking concentrator, one-axis tracking concentrator, and two-axis tracking concentrator. Solar equipment cost estimates, annual energy capacity cost, and optional net present worth analysis are provided by ECONMAT. User input consists of detailed industrial process information and optional economic parameters. Internal program data includes meteorological information for 248 US sites, characteristics of more than

20 commercially available collectors representing several generic collector types, and defaults the economic parameters. Because a fullscale conventional back-up fuel system is assumed, storage is not essential and is not included in the model. DOE

N80-24825# Massachusetts Inst. of Tech., Cambridge.
PHOTOCHEMICAL ENERGY STORAGE: STUDIES OF INORGANIC PHOTOASSISTANCE AGENTS Progress Report, 11 Dec. 1978 - 31 Mar. 1980
M. S. Wrighton Dec. 1979 23 p refs
(Contract EY-76-S-02-4178)
(COO-4178-3) Avail: NTIS HC A02/MF A01

Research was focused on the study of chemically derived photoelectrodes for conversion of light to electricity or fuels. Examples of completed research are given in the list of publications. Highlights of the period include (1) study of the derivatized n-type Si photoanode for oxidation of water soluble species such as I(-) Fe(CN)6(4-), and Ru(NH3)6(2+); (2) demonstration that heterogeneous electron transfer rates between a surface-confined, photogenerated reagent and a solution reagent can be measured; (3) demonstration that Fermi level pinning obtains for p-type semiconductors such as Si, GaAs, and InP; (4) strained Si-C bonds can be used to functionalize surfaces; and (5) study of catalysis of H2 evolution from illuminated p-type semiconductors. DOE

N80-24826# Foster Wheeler Corp., Livingston, N.J.
SOLAR PRODUCTION OF INDUSTRIAL PROCESS STEAM RANGING IN TEMPERATURE FROM 300 F TO 550 F (PHASE 1), VOLUME 1 Final Report, 30 Sep. 1978 - 30 Jun. 1979
30 Jun. 1979 176 p refs
(Contract ET-78-C-03-2199)
(DOE/CS/32199-1; FWDC-9-41-4010) Avail: NTIS HC A09/MF A01

This section summarizes the Phase 1 solar industrial process steam system and includes a system schematic, a brief system description, general specifications of the major system components, expected system performance, and a cost estimate summary for Phases 2 and 3. The objectives of Phase 1 are: (1) design a cost-effective solar steam generating system using state-of-the-art components and technology to supply steam for Dow Chemical Company's Dalton, Georgia, plant; (2) predict the performance of the solar process steam plant; (3) conduct a safety evaluation and an environmental impact assessment of the solar steam system; (4) conduct an economic analysis to determine the potential economic benefits of a solar-augmented process steam production system compared with an existing fossil-fuel-fired steam generator; and (5) promote the project extensively to make it visible to industry and the general public. DOE

N80-24827# Duke Univ., Durham, N. C. Dept. of Mechanical Engineering and Materials Science.
PREPARATION AND CHARACTERIZATION OF HYDROGENATED AMORPHOUS SILICON THIN FILMS AND THIN FILM SOLAR CELLS PRODUCED BY ION PLATING TECHNIQUES Quarterly Progress Report, 1 Apr. - 30 Jun. 1979
Franklin H. Cocks, Phillip L. Jones, and Louis Dimmey Sep. 1979 23 p refs
(Contract DE-AC03-79ET-23041)
(DOE/ET/23035-2) Avail: NTIS HC A02/MF A01

Using quartz substrates, hydrogenated a-Si thin films were produced both by glow discharge decomposition of silane and by the controlled ion plating of high purity through glow discharges composed of silane, hydrogen, and argon using a modified Takagi apparatus. Thus far, thin films produced by both glow discharge decomposition of silane with and without magnetic confinement and by ion plating have been characterized and compared using X-ray defractometry, infrared spectroscopy, optical absorption spectroscopy and by their temperature dependence of resistivity. Based on these results, the ion plating technique of producing a-Si thin films looks extremely encouraging. Films were produced at approximately ten times the deposition rate obtained using glow discharge decomposition of silane, even with magnetic field containment. In addition the resulting thin film properties measured to date compared favorably with those obtained from our glow discharge produced films and the properties of glow discharge produced films reported in the literature. DOE

N80-24828# American Science and Engineering, Inc., Cambridge, Mass.
DEVELOPMENT OF A SECOND-GENERATION CONCENTRATING TRACKING SOLAR COLLECTOR Technical Progress Report, 20 Jun. - 27 Dec. 1978
Roy W. Miller 16 Jan. 1979 58 p refs
(Contract EM-78-C-04-4375)
(ASE-4371) Avail: NTIS HC A04/MF A01

The objective is to develop a second generation parabolic mirror concentrator with a variation of the cylindrical blackbody receiver to provide a minimum concentration ratio of ten. Performance characteristics are to be determined by tests using a prototype unit. Probable mass production costs for the collector will be generated. Work performed during the first six months of the effort is described. The design of the prototype collector was completed. The collector design is described in detail. The performance analysis for the second generation collector was also completed during the first six months of the contract. The work consists of collector tradeoff studies together with optical and thermal analysis of detailed configurations. The analysis is described in detail with computer programs included and results given for conditions of interest. The performance analysis was conducted in concert with the collector design effort. Thus, the collector design features were driven by performance considerations and design details are optimum with respect to performance. The result is a collector design capable of producing outlet field of high enough temperature to drive air conditioning equipment. Concentration ratio is 12 and predicted efficiency is 60% at fluid outlet temperature of 200 F. DOE

N80-24829# Aerospace Corp., Los Angeles, Calif. Energy Systems Directorate.
NEW APPLICATIONS OF HIGH-TEMPERATURE SOLAR ENERGY FOR THE PRODUCTION OF TRANSPORTABLE FUELS AND CHEMICALS AND FOR ENERGY STORAGE
19 Jan. 1979 178 p refs
(Contract EY-76-C-03-1101)
(ATR-78(7891-04)-1) Avail: NTIS HC A09/MF A01

The solar fuels and chemicals study was limited to the examination of processes requiring temperatures in excess of 1000 K since lower temperature processes had already been examined in studies concerned with the application of waste heat from nuclear power plants to industrial processes. In developing the carbon cycle processes, the primary activity included an extensive literature search and the thermodynamic evaluation of a number of candidate chemical cycles. Although both hydrogen and carbon closed- and open-loop chemical cycles were studied, it was concluded that the carbon cycles offered sufficient additional potential to warrant concentrating on them in subsequent work. The section on new ideas for transportable fuels presents the elements of a new concept for a carbon cycle recovery technique to produce transportable fuels. The elements discussed are sources of carbon dioxide, solar energy reduction of CO2, potential carbon cycles, and use of carbon monoxide as fuel and feedstocks. Another section presents some new concepts for the use of high temperature solar energy in the production of essential materials and for closed-loop chemical storage, as well as for the production of hydrogen as a fuel and open-loop applications. Potential problem areas pertinent to solar derived fuels and chemicals have been identified. These problems are primarily associated with the limited high temperature experience in industry and include materials compatibility, separation of reaction products, development of solid electrolytes and high temperature electrodes, selective emission of receiver coatings at high temperature, and a lack of chemical kinetics data, and high temperature thermodynamic data. DOE

N80-24830# Lockheed Missiles and Space Co., Palo Alto, Calif.
CADMIUM SULFIDE/COOPER SULFIDE HETEROJUNCTION CELL RESEARCH Technical Progress Report, 26 Feb. - 31 May 1979
W. W. Anderson Jun. 1979 21 p refs
(Contract EG-77-C-03-1459)
(DSE-1459-T1; LMSC-D-676741) Avail: NTIS

HC A02/MF A01

All vacuum deposition process AuCu2SCd(1-x)Zn(x)SNb photovoltaic cells were fabricated by sequentially sputtering (1) Nb in Ar, (2) Cd(1-x)Zn(x), and then (3) Cu in H2S and Ar gas mixtures, and finally, in a separate operation, (4) Au in Ar. Photovoltaic response of As-deposited junctions (i.e., without subsequent heat treatment) was obtained with appropriate deposition parameters. Resistivity of CdS or Cd(o(9)Zn(o(1)S films was controlled by sputtering from In-doped metal cathodes. Junction characteristics were strongly influenced by deep trap levels on the Cd(1-x)Zn(x)S side of the heterojunction. A trap level at E(t) approx. = 0.37 eV below the conduction band edge was identified in sputter deposited CdS by admittance spectroscopy. DOE

N80-24831# Midwest Research Inst., Golden, Colo.
BIOLOGICAL SOLAR CELLS
M. Seibert and A. F. Janzen Nov. 1979 7 p refs Presented at the 2nd Miami Intern. Conf. on Alternative Energy Sources, Miami Beach, Fla., 10 Dec. 1979 Prepared in cooperation with Photochemical Research Associates, Inc., London (Canada).
(Contract EG-77-C-01-4042)
(SERI/TP-332-476; CONF-791204-7) Avail: NTIS HC A02/MF A01

The bacterial photosynthetic reaction center isolated from Rhodopseudomonas sphaeroides was attached directly onto an SnO2 electrode. The light-induced primary charge separation processes which occur across the reaction center macromolecule were then coupled to the electrode. In a two-electrode configuration, photovoltages as high as 70 mV and photocurrents as high as 0.5 micron A/sq cm are observed in an external circuit. Such reaction center electrodes may be the forerunner of future biological solar cells or may serve as model systems for future organic photovoltaic devices. DOE

N80-24832# Sandia Labs., Albuquerque, N. Mex.
PHOTOVOLTAIC CONCENTRATORS
E. C. Boes 1980 10 p refs Presented at the 14th Photovoltaics Specialist Conf., San Diego, Calif., 7 Jan. 1980
(Contract EY-76-C-04-0789)
(SAND-80-0143C; CONF-800106-7) Avail: NTIS HC A02/MF A01

A status report on photovoltaic (PV) concentrators technology is presented. The major topics covered are as follows: (1) current PV concentrator arrays; designs, performances, and costs; (2) current PV concentrator array components; cells and cell assemblies, optical concentrators, support structures, tracking, and drive; (3) design of PV concentrator arrays; and (4) array manufacturing technology. DOE

N80-24833# Sandia Labs., Albuquerque, N. Mex. Large Power Systems Div.
SOLAR CENTRAL RECEIVER SYSTEMS PROGRAMS
J. D. Fish 1979 5 p refs Presented at the Solar Ind. Process Heat Conf., San Francisco, 31 Oct. 1979
(Contract EY-76-C-04-0789)
(SAND-79-8777; CONF-791024-5) Avail: NTIS HC A02/MF A01

Major elements of the Solar Central Receiver Systems program include: (1) development of storage-coupled and hybrid system concepts; (2) the Central Receiver Test Facility in Albuquerque, NM; (3) the pilot plant under construction at Barstow, CA; (4) proposed repowering/industrial retrofit plants; and (5) heliostat, receiver, and storage subsystems development work. Current and proposed activities within each element are discussed. DOE

N80-24834# Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
OCEAN THERMAL ENERGY CONVERSION: A STATE-OF-THE-ART STUDY
A. Douglas Carmichael Jul. 1979 84 p Sponsored by EPRI
(EPRI-ER-1113-SR) Avail: NTIS HC A05/MF A01

A baseline ocean thermal energy conversion unit composed of eight 50 MW power modules was studied and defined. It was concluded that OTEC system is technically feasible and could operate year round in some regions of the Gulf of Mexico, off Hawaii, and off Puerto Rico. The closed Rankine cycle using ammonia as the working fluids is probably the best power plant system to utilize the small temperature differences of about 40 F between the warm surface water and the cold water taken from a depth of about 3280 ft. The most important components in the power plant are the large heat exchanges and the major technical problems are anticipated with these components. The platform will probably have a ship or barge configuration with the long cold water pipe supported from the midships region. The estimated costs of the baseline system were established from recent design studies. The total capital investment (excluding the cables to shore) was estimated to be about $3000 per kW. DOE

N80-24835# Argonne National Lab., Ill. Energy and Environmental Systems Div.
OTEC PERFORMANCE TESTS OF THE CARNEGIE-MELON UNIVERSITY VERTICAL FLUTED-TUBE CONDENSER
L. G. Lewis and N. F. Sather May 1979 45 p refs
(Contract W-31-109-eng-38)
(ANL/OTEC-PS-4) Avail: NTIS HC A03/MF A01

Performance tests results on a vertical fluted-tube condenser are reported. The condenser was free of operational problems and performed in a stable and repeatable manner. At nominal design conditions (a heat duty of 3.2 million Btu/hr and a water flow rate of 3200 gpm), the overall heat transfer coefficient (U sub zero) was 1040 Btu/hr sq ft F and the water-side pressure drop was 3.3 psi. Varying the quality of the ammonia vapor feed to the condenser (in the range of 90 to 100 percent) did not affect performance. On the other hand, when the heat duty was increased from 2.3 million to 4.0 million Btu/hr U sub zero rose from 1024 to 105 Btu/hr sq ft F. This trend resulted from an increase in the amonnia-side coefficient over this range of heat duties. Finally, the water side coefficient was about 2.45 times greater than that calculated from the Sieder-Tate equation for smooth circular tubes of the same cross-sectional area. This enhancement ratio of 2.45 was some 20 percent greater than the enhancement factor of 2.07 expected from the increase in surface area alone. DOE

N80-24836# Mitre Corp., McLean, Va. METREK Div.
SOLAR THERMAL REPOWERING: UTILITY/INDUSTRY MARKET POTENTIAL IN THE SOUTHWEST
N. Lord, P. Curto, and S. True Dec. 1978 177 p refs
(Contract ET-78-C-01-2854)
(MTR-7919) Avail: NTIS HC A09/MF A01

An analysis of the utility and industrial solar thermal repowering market potential in the Southwest is presented. Repowering involves adding the solar thermal central receiver (power tower) system as a retrofit power source for existing utilities and industries. It would provide steam to drive utility turbogenerator or supply process heat for industry. The potential for repowering oil and gas using steam turbine utility sites with a capacity greater than 25 MWe and sufficient land adjacent to the plant for a minimum 25 MWe addition is analyzed. Industry projections based on an analysis of the energy requirements for the chemicals and petroleum industries in Texas and estimates of land availability are included. It is estimated that the potential solar thermal repowering market for utilities and industries in the Southwest is approximately one quad. DOE

N80-24837# Massachusetts Inst. of Tech., Cambridge.
BATTERY CHARGE/SOLAR CONTROLLER FOR A RESIDENTIAL SIZE PHOTOVOLTAIC POWER SYSTEM
R. N. Cadieux 31 Oct. 1979 20 p refs
(Contract EY-76-C-02-4094)
(COO-4094-62) Avail: NTIS HC A02/MF A01

A controller was designed to meet the initial requirements of an off-peak, utility-interactive solar photovoltaic power system now undergoing tests. A physical description of the controller, an explanation of the control algorithm, a circuit description and the theory of operation are presented. DOE

N80-24838# Georgetown Univ., Washington, D.C.
GEORGETOWN UNIVERSITY GENERIC INTEGRATED COMMUNITY ENERGY SYSTEM GU ICES DEMONSTRATION PROJECT. MODIFIED WORK MANAGEMENT PLAN Final Report
Apr. 1979 330 p refs
(Contract EC-77-C-02-4488)

(COO-4488-2) Avail: NTIS HC A14/MF A01

This Phase 2 Modified Work Management Plan reflects the change from a Coal Using ICES to a Generic ICES Program. Book 2 deals with an energy audit conducted at the campus in the fall of 1978 to establish a gross baseline from which to measure and evaluate the contributions of selected alternative energy subsystems both from an energy and cost standpoint. Book 1 proceeds from a discussion of an ICES through an explanation of the scope of effort in each phase expanded into detailed task descriptions by phase together with schedules, PERT and GANTT charts, milestones and levels of effort by task for the Feasibility Analysis, and schedules for the overall program. A description of examples of alternative subsystems to be considered is also included. A detailed Management Plan for the conduct of the effort by General Electric completes the plan. Appendices related to cogeneration, life cycle costing, GE energy subsystems, the GU Master Energy Plan, and typical regulatory processes to be encountered are included. Book 2 treats the Energy Audit under the three committed task areas of System Description, Analysis and Survey, and Criteria for Energy Usage. The five major energy systems utilized at Georgetown are considered: electrical, chilled water, steam, gas and fuel oil, and city water. A top level analysis yields significant results and recommendations for further action with respect to a detailed measurements program, particularly of steam and electric power usage, over a one year period. DOE

N80-24839# Delaware Univ., Newark. Inst. of Energy Conversion.

AMORPHOUS Si SOLAR CELLS Quarterly Report, 1 Apr. - 30 Jun. 1979

V. L. Dalal Aug. 1979 56 p refs

(Contract DE-AC03-79ET-23034)

(DOE/ET/23034-T1; QR-2) Avail: NTIS HC A04/MF A01

An analysis of a-Si devices was completed. The analysis shows that even with limited diffusion length and high defect density, a-Si devices can achieve J/sub sc/ approximately = to 15 mA/sq cm, V/sub oc/ approximately = to IV and FF approximately = to 0.72. Novel a-Si devices were also designed and analyzed. The analysis shows that the flexibility in material properties offered by a-Si can be used advantageously to design high quality devices. DOE

N80-24840# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.

APPLICATION OF CIRCUMSOLAR MEASUREMENTS TO CONCENTRATING COLLECTORS

D. F. Grether, D. Evans, A. Hunt, and M. Wahlig Jun. 1979 6 p refs Presented at the Intern. Solar Energy Soc. Meeting, Atlanta, 28 May 1979

(Contract W-7405-eng-48)

(LBL-9412; CONF-790541-58) Avail: NTIS HC A02/MF A01

A systematic measurement program is being carried out to assess the effects of circumsolar radiation (the solar aureole) on the performance of solar conversion systems using concentrating collectors. Four instrument systems were constructed and are providing detailed intensity vs. angle profiles of the solar and circumsolar (out to 3 deg from the center of the Sun) as well as other solar measurements. The instruments are briefly described. Results are presented of the average effect of the circumsolar radiation on the solar energy available to an idealized point focusing system. Results are also presented for an analysis of two specfic central receiver designs. DOE

N80-24841# EIC, Inc., Newton, Mass.

SYNTHESIS, EVALUATION, AND DEFECT COMPENSATION OF TETRAHEDRAL GLASSES AS POSSIBLE SOLAR CELL MATERIALS Quarterly Technical Progress Report, 1 May - 31 Jul. 1979

R. D. Rauh Sep. 1979 18 p refs

(Contract DE-AC03-79ET-23039)

(DOE/ET/23039-2) Avail: NTIS HC A02/MF A01

Work performed on the project to synthesize A/sup II/B/sup IV/C2/su V/ glasses and evaluate their potential use as solar cell materials is described. The major effort was directed towards preparation of these films by thermal evaporation of compounds synthesized during the first quarter. Films were produced from CdAs2, CdSnAs2, CdSiAs2, ZnSiAs2 and ZnAs2. Only films from the last compound had a stoichiometry comparable to the starting material. The ternary films were deficient in the group IV element and films produced from CdAs2 indicated the sample had undergone extensive decomposition. In addition to having good stoichiometries, the X-ray analysis of the ZnAs2 films indicated they were amorphous. The work thus represents the first reported results of preparation of amorphous films of ZnAs2. DOE

N80-24842# Sandia Labs., Albuquerque, N. Mex.

EXTRINSIC LOSSES IN SOLAR CELLS FOR LINEAR FOCUS SYSTEMS 4

C. Michael Garner Dec. 1979 42 p refs

(Contract EY-76-C-04-0789)

(SAND-79-1781) Avail: NTIS HC A03/MF A01

Solar cell efficiency is dependent on the intrinsic one dimensional diode efficiency and on the extrinsic losses (i.e., contact shadowing, series resistance and losses arising from nonuniform illumination). These extrinsic losses can depend on cell size and should be considered in the design of concentrator systems. The carrier transport and junction phenomena are arbitarily called intrinsic effects, and the efficiency resulting from the one dimensional transport equations will be called the intrinsic efficiency. The under consideration will be called extrinsic effects. The I sq R and shadowing losses have been calculated as a function of cell size, contact thickness and number of buses. In addition, losses resulting from nonuniform illumination and temperature have been calculated. These results should give clear guidelines for the design of receivers for linear focus systems. DOE

N80-24843# Argonne National Lab., Ill. Energy and Environmental Systems.

PROCEDURES FOR SAFE HANDLING OF OFF-GASES FROM ELECTRIC VEHICLE LEAD-ACID BATTERIES DURING OVERCHARGE

S. J. LaBelle, M. H. Bhattacharyya, R. O. Loutfy, and R. Varma 25 Jan. 1980 20 p refs

(Contract W-31-109-eng-38)

(ANL/CNSV-TM-28) Avail: NTIS HC A02/MF A01

The potential for generation of toxic gases from lead-acid batteries has long been recognized. Prior to the current interest in electric vehicles, there were no studies specifically oriented to toxic gas release from traction batteries, however. As the Department of Energy Demonstration Project (in the Electric and Hybrid Vehicle Program) progresses, available data from past studies and parallel health effects programs must be digested into guidance to the drivers and maintenance personnel, tailored to their contact with electric vehicles. The basic aspects of lead-acid battery operation, vehicle use, and health effects of stibine and arsine to provide electric vehicle users with the information behind the judgment that vehicle operation and testing may proceed are presented. Specifically, it is concluded that stibine generation or arsine generation at rapid enough rates to induce acute toxic response is not at all likely. Procedures to guard against low-level exposure until more definitive data on ambient concentrations of the gases are collected are presented for both charging the batteries and driving the vehicles. A research plan to collect additional quantitative data from electric traction batteries is presented. DOE

N80-24844# Battelle Pacific Northwest Labs., Richland, Wash.

HELIOSTAT MANUFACTURING COST ANALYSIS, VOLUME 1 Final Report

K. Drumheller, Steven C. Schulte, Ron A. Dilbeck, and Lloyd W. Long Oct. 1979 83 p refs Prepared for Midwest Research Inst., Golden, Colo.

(Contracts EG-77-C-01-4042; EY-76-C-06-1830)

(SERI/TR-8043-Vol-1) Avail: NTIS HC A05/MF A01

This study has two primary objectives. The first is to provide a detailed cost evaluation of the second generation of DOE heliostats, from which repowering heliostat designs are likely to be derived. A second objective is to provide an analytical foundation for the evaluation of future heliostat designs. The approach taken was to produce a cost estimate for the production of the prototype design by generating estimates of the materials, labor, overhead, and facilities costs for two different production scenarios, 25,000 heliostats per year and 250,000 heliostats

per year. The primary conclusion is that the second generation of heliostat designs should cost approximately $100/sq m at volumes of 25,000 units/year. This price falls to approximately $80/sq m at volumes of 250,000 units/year. A second conclusion is that cost reduction begins at relatively low production volumes and that many production benefits can be obtained at production rates of 5,000 to 15,000 units/year. A third conclusion is that the SAMICS model and the SAMIS III program can be useful tools in heliostat manufacturing costing, and economic studies. DOE

N80-24845# Pennsylvania State Univ., University Park. Materials Research Labs.
CONTROLLED CADMIUM TELLURIDE THIN FILMS FOR SOLAR CELL APPLICATIONS (EMERGING MATERIALS SYSTEMS FOR SOLAR CELL APPLICATIONS) Quarterly Progress Report, 9 Apr. - 8 Jul. 1979
K. Vedam Aug. 1979 12 p refs
(Contract DE-AC02-79ET-23013)
(DOE/ET/23013-T2; QPR-1) Avail: NTIS HC A02/MF A01

Preparation and properties of cadmium telluride thin films for use in solar cells are studied. CdTe sputter deposition, crystal doping, and carrier typing are discussed. Future experimental plans are described. DOE

N80-24846# California Univ., Livermore. Lawrence Livermore Lab.
WEIGHT AND VOLUME ESTIMATES FOR ALUMINUM-AIR BATTERIES DESIGNED FOR ELECTRIC VEHICLE APPLICATIONS
J. F. Cooper Jan. 1980 19 p refs Presented at the 1st Intern. Workshop on Reactive Metal-Air Batteries, Bonn, 9-11 Jul. 1979
(Contract W-7405-eng-48)
(UCRL-83881; CONF-790759-3) Avail: NTIS HC A02/MF A01

The weights and volumes of reactants, electrolyte, and hardware components are estimated for an aluminum-air battery designed for a 40-kW (peak), 70-kWh aluminum-air battery. Generalized equations are derived which express battery power and energy content as functions of total anode area, aluminum-anode weight, and discharge current density. Equations are also presented which express total battery weight and volume as linear combinations of the variables, anode area and anode weight. The sizing and placement of battery components within the engine compartment of typical five-passenger vehicles is briefly discussed. DOE

N80-24847# Westinghouse Research and Development Center, Pittsburgh, Pa.
CADMIUM SULFIDE/COPPER SULFIDE HETEROJUNCTION CELL RESEARCH Final Report, 30 Sep. 1977 - 31 Jul. 1979
J. R. Szedon, F. A. Shirland, W. J. Biter, T. W. OKeeffe, J. A. Stoll, and S. J. Fonash (Pennsylvania State Univ., University Park) 31 Jul. 1979 186 p refs
(Contract EG-77-C-03-1577)
(DOE/ET/20429-1) Avail: NTIS HC A09/MF A01

The objective of this program is to conduct research on solar cells of the copper sulfide/cadmium sulfide (and cadmium sulfide-zinc sulfide alloy) type with the goal of producing thin film cells capable of 10% AM1 conversion efficiency with less than 5% degradation in performance over a period of 20 years. New evaluation methods reveal cell microstructure details (grain size, Cu2S penetration into grain boundaries, etch pit depth and density) whose modification and control should allow reproducible achievement of at least 9% conversion efficiency. Cell degradation primarily involves changes in heterojunction collection efficiency, not minority carrier transport in the thin CU2S, light absorbing layer. Analysis of current technology predicts a selling price of $0.53/peak watt(1975 dollars) for glass encapsulated, 8% efficient modules. More conservative material use, especially gold grid electrode, should allow a selling price of $0.38/peak watt. DOE

N80-24848# United Engineers and Constructors, Inc., Philadelphia, Pa.
ENERGY ECONOMIC DATA BASE (EEDB) PROGRAM: PHASE 1: INITIAL UPDATE Final Report
Dec. 1979 210 p refs
(Contract EN-78-C-02-4954)
(COO-4954-1-Vol-3) Avail: NTIS HC A10/MF A01

Volume 1 describes the EEDB and presents some pertinent update material. The initial appendices make up Volume 2 in which descriptions of the Standard Hypothetical Middletown Sites for nuclear power plants and coal-fired power plants are presented. Additional data in appendices in Volume 2 include information on fuel-cycle work; inflation-free fixed charge rates; capital cost update procedure; and nuclear steam supply system. This Volume 3, contains additional appendices entitled: Practical Target Economics for the Liquid Metal Fast Breeder Reactor Nuclear Power Generating Station; Air-Quality Impact Analysis for determination of the Acceptability of Qualified High and Low-sulfur Coal-fired Facility Designs for the Hypothetical Middletown Site; Synthetic Power Plant Fuels by the Solvent Refined Coal Process; Inflation Free Fuel Cycle Costs for Throwaway and Recycle Cases; Inflated (6%) Fuel Cycle cost for Throwaway and Recycle cases; Inflated (7%) Fuel cost for Throwaway and Recycle Cases; Inflated (8%) Fuel Cycle Costs for Throwaway and Recycle Cases; Fuel Costing Methodology; and Bred-Fuel Scenarios. DOE

N80-24849# Science Applications, Inc., La Jolla, Calif.
CALIFORNIA THERMAL OIL UTILIZATION. VOLUME 1: EXECUTIVE SUMMARY Final Report
R. Colman and E. W. Standley Dec. 1979 385 p refs
(Contract ET-78-C-03-1864)
(SAN-1864-1) Avail: NTIS HC A17/MF A01

The potential for significant increases in California thermally produced crude oil (CTO) production and utilization by 1985 was studied. The DOE goal of 900,000 barrels/day of total CTO production by 1985 was evaluated. The constraints to increased CTO production were discussed. Incentives for increasing production were recommended. Physical and chemical properties, conventional refining processes, and alternate technologies for CTO were also discussed. DOE

N80-24850# RCA Labs., Princeton, N. J.
AMORPHOUS THIN FILMS FOR SOLAR CELL APPLICATIONS Quarterly Report, 12 Apr. - 11 Jul. 1979
D. E. Carlson, I. Balberg, R. S. Crandall, B. Goldstein, J Hanak, J., J. I. Pankove, and D.L. Staebler Jul. 1979 109 p refs
(Contract ET-78-C-03-2219)
(SAN-2219-3; QR-3) Avail: NTIS HC A06/MF A01

A theory for the capture of electrons by deep centers in hydrogenerated amorphous silicon (a-Si:H) is presented. Some recent results obtained with the RF magnetron deposition system are described. Other results show that additions of Ar to dc or ac SiH4 discharges cause the dark conductivity and photoconductivity to increase. Other data show that the addition of SiF4 to SiH4 discharges cause the photoluminescence intensity to decrease. Recent work involving photoconductivity spectra, the photoelectromagnetic effect, and the Hall effect in undoped a-Si:H is briefly described. Measurements of the surface photovoltage were used to estimate the distribution of surface states on a-Si:H. Tunneling measurements were used to characterize the surface and bulk states in MIS junctions. A new technique for determining the optical absorption in the band-tail states in a-Si:H is described. Information on stacked on multiple junction a-Si:H solar cells and on large area, series-connected cells is given. The influence of photoconductive gain on the fill factor of a-Si:H cells is discussed and an upper limit of approximately 380 A is established for the hole diffusion length in a-Si:H films made in an RF capacitive discharge. DOE

N80-24851# Radiation Monitoring Devices, Inc., Watertown, Mass.
HIGH EFFICIENCY THIN FILM CdTe SOLAR CELLS Quarterly Progress Report, 19 Mar. - 18 Jun. 1979
H. B. Serreze, G. Entine, and R. B. Goldner Jul. 1979 17 p refs
(Contract DE-AC04-79ET-23012)
(DOE/ET/23012-T1; QPR-1) Avail: NTIS HC A02/MF A01

Facilities for the high vacuum evaporation of thin film CdTe were prepared. A number of evaporations were performed of both p-type (phosphorus doped) and n-type (halogen doped) CdTe on both conductive and nonconductive substrates. Optical,

physical, and electrical evaluations were made. Initial results indicate that the films are predominantly cubic, but that film resistivity is generally still too high and that an anomalous barrier exists at the ITO/n-CdTe interface. DOE

N80-24852# Institute for Energy Analysis, Washington, D.C.
FRANCE: ESTIMATES OF FUTURE ENERGY/GDP RELATIONSHIPS
Edward L. Allen Dec. 1979 67 p refs
(Contracts EY-76-C-05-0033; DE-AC05-76OR-00033)
(ORAU/IEA-79-23(M)) Avail: NTIS HC A04/MF A01

Compared with other OECD nations, France's postwar economic growth has been above average. Gross domestic product (GDP) grew at an annual rate of 4.1% in the 1970s. A high rate of new investment (fixed, nonresidential investment) was achieved during these years to bolster productivity gains. Since France depends primarily on imports for its energy supplies, energy use has become relatively efficient. Government policy emphasizes energy saving in all sectors; the E/GDP ratio increased only slightly to 1973 and thereafter fell sharply. As to the future, economic growth, as measured by GDP, is expected to moderate over the balance of this century, to a level of 2.8% annually by the 1995-2000 period. Labor force growth will decline because of decreased domestic fertility and the more restrictive immigration policy. In addition, the length of the workweek, which has remained relatively high, is expected to follow the declining trend already evident in other OECD countries. DOE

N80-24853# FMC Corp., Santa Clara, Calif. Engineered Systems Div.
LINE FOCUS SOLAR THERMAL CENTRAL RECEIVER RESEARCH STUDY Final Report, 30 Apr. 1977 - 31 Mar. 1979
D. G. DiCanio, William J. Treytl, Frank A. Jur, and C. Don Watson Apr. 1979 314 p refs
(Contract EY-76-C-03-1246)
(DOE/ET/20426-1) Avail: NTIS HC A14/MF A01

The results of a study to examine the line focus central receiver alternative for solar thermal generation of electric power on a commercial scale are presented. The baseline concept consists of the following elements: (1) A solar collector (heliostat) whose geometry is the equivalent of a focused parabolic cylinder. The heliostat reflecting surface is composed of an array of flexible rectangular mirror panels supported along their long edges by a framework which rotates about an axis parallel to the ground plane. (2) A linear cavity receiver, composed of 61 meter (200-foot) sections supported by towers at an elevation of 61 meters (200 feet). Each section receives feedwater and produces turbine-rated steam. (3) Heliostat control, consisting of a local controller at each heliostat module which communicates with a master control computer to perform elevation tracking and focal length adjustment. The control logic is open-loop, with sun position computer by the master computer with an algorithm. DOE

N80-24854# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Labs.
THIN FILM POLYCRYSTALLINE SILICON SOLAR CELLS Quarterly Report, 1 Apr. - 30 Jun. 1979
A. K. Ghosh, Tom Feng, H. Paul Maruska, and Charles Fishman 1979 45 p refs
(Contract DE-AC02-79ET-23047)
(DOE/ET/23047-T1; QR-2) Avail: NTIS HC A03/MF A01

The theory of polycrystalline solar cells was extended by introducing effects due to the reduction of grain boundary states. The results show that a large improvement in efficiency can be attained either by increasing the grain size or by passivating the grain boundary states to reduce the number of recombination centers. Experimental results are presented to show grain size distribution in Wacker polycrystalline silicon. Preliminary Hall mobility measurements are presented as a function of temperature. Experimental results and analysis of diffused p on n cells are reported. Preliminary studies of grain boundary passivation and stability of SnO2/n-Si solar cells are presented. DOE

N80-24855# Aerospace Corp., Los Angeles, Calif. Energy and Resources Div.
SOLAR THERMAL SMALL POWER SYSTEMS STUDY. PHASE 2: STUDY RESULTS
D. E. Lapedes, P. K. Munjal, and L. R. Sitney 12 Jul. 1979 239 p refs
(Contract ET-78-C-03-2226)
(DOE/ET/20516-2) Avail: NTIS HC A11/MF A01

This study of small solar power systems (SSPS) was structured to determine conditions under which SSPS can be cost-effective sources of electric power in the US in the period 1985 to 2015. An extensive data base, which provides a discrete identification of all utility and industrial electric generating units up to ans including 10 MW/sub e/ in rated capacity, was prepared. This data base defines the market for which comparative evaluations are made of SSPS and alternative fossil-fueled power plants. The market penetration of SSPS is determined and the effect of economic incentives on accelerating the penetration is evaluated. The solar electric power system is evaluated as either a complete replacement for existing conventional electric power systems or as a repowering installation for boilers supplying steam to turbine-driven generators. The cost data used in the market penetration analysis are for a central receiver-type of small solar thermal power system. While the market penetration discussed is for this type of SSPS, the sensitivity data in the report can be used to determine the market penetration of other types of solar thermal power systems (e.g., point focus distributed receiver) with different system costs. DOE

N80-24856# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
VACUUM DEPOSITED POLYCRYSTALLINE SILICON FILMS FOR SOLAR CELL APPLICATIONS Quarterly Report, 1 Apr. - 30 Jun. 1979
Charles Feldman and Frank G. Satkiewicz Aug. 1979 55 p refs
(Contract ET-78-C-02-3208)
(DOE/ET/32208-3) Avail: NTIS HC A04/MF A01

Research was conducted on grain growth phenomena and interface interactions pertaining to an all-vacuum deposition technique for fabricating thin-film polycrystalline silicon solar cells. Investigations dealt primarily with the structure silicon/TiB2/alumina substrate, which seems to be the most satisfactory from the standpoint of stability and potential applicability to low-cost solar cells. Deposition of silicon in the presence of hydrogen resulted in devices inferior to those fabricated in high vacuum. Silicon growth from the TiB2 coated substrates was observed to start from larger seeds than was observed on bare alumina substrates. The larger silicon crystallites observed on the TiB2/alumina are believed to arise from growth on an intermediate Ti-Si phase. A series of experiments on top electrode preparation indicates that Ti/Ag electrodes heated for 30 min at 500 C in air gives the best results for the polycrystalline devices as they are presently constructed. DOE

N80-24857# Sandia Labs., Albuquerque, N. Mex.
QUALIFICATION TESTING OF PHOTOVOLTAIC CONCENTRATOR MODULES FOR SYSTEM APPLICATION EXPERIMENTS
J. F. McDowell, D. A. Pritchard, and A. E. Verardo 1980 14 p Presented at the 14th Photovoltaics Specialists Conf., San Diego, Calif., 7 Jan. 1980
(Contract EY-76-C-04-0789)
(SAND-80-0112C; CONF-800106-12) Avail: NTIS HC A02/MF A01

Concentrator module performance qualification testing is described. The nature of the qualification tests, the control and data acquisition systems used and typical performance data on representative modules are discussed. Qualification testing is to be performed on modules assembled by final production processes and is designed to identify design/construction weaknesses rather than measure life expectancy. Three trackers will be used as will three independent computer-controlled data acquisition systems. The basic elements are the computer, control equipment, data acquisition instruments, a portable thermal loop, and programmable electronic load. DOE

N80-24858# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
PERFORMANCE EVALUATION OF A SOLAR AIR-HEATING AND NOCTURNAL COOLING SYSTEM IN CSU SOLAR

HOUSE 2 Final Report, 1 Jun. 1977 - 30 Sep. 1978
Susumu Kanshi Apr. 1979 173 p refs
(Contract EY-76-S-02-2868)
(COO-2868-5) Avail: NTIS HC A08/MF A01

The solar heating system in Colorado solar house No.2 consists of 67.1 sq m of double glazed air-heating collectors with flat-black absorbers, 10.3 cu m of pebble bed storage, air-to-water heat exchanger for preheating domestic water, and one blower to circulate the air through the system. The nocturnal cooling system consists of an evaporative cooler and utilizes the pebble bed for cool storage. A schematic diagram of the system is presented. DOE

N80-24858# California Univ., Livermore. Lawrence Livermore Lab.
PROSPECTS FOR USING IMPROVED CLIMATE INFORMATION TO BETTER MANAGE ENERGY SYSTEMS
William J. Quirk and John E. Moriarty (Federal Energy Regulatory Commission, Washington, D.C.) Jan. 1980 12 p refs Presented at the Intern. Workshop on Energy/Climate Interactions, Munster, W. Germany, 3-7 Mar. 1980
(Contract W-7405-eng-48)
(UCRL-83813; CONF-800309-2) Avail: NTIS HC A02/MF A01

The impacts that climate anomalies have had on energy systems in the United States, and the resulting impacts on society are described. It is pointed out that better use of climate information could alleviate some of the adverse consequences of these anomalies. The possibility of international cooperation in using climate information to avoid potentially worsening conditions during a global energy shortage is also examined. DOE

N80-24860# Alabama Univ., University. Bureau of Engineering Research.
HEAT-PUMP-CENTERED INTEGRATED COMMUNITY ENERGY SYSTEMS Final Report
Walter J. Schaetzle, C. Everett Brett, and Marvin S. Seppanen Dec. 1979 283 p refs Supersedes ANL/ICES-TM-30
(Contract W-31-109-eng-38)
(ANL/CNSV-TM-25; ANL/ICES-TM-30) Avail: NTIS HC A13/MF A01

The heat-pump-centered integrated community energy system supplies district heating and cooling using heat pumps and a thermal energy storage which is provided by nature in underground porous formations filled with water, i.e., aquifers. The proposed system was analyzed as demonstration projects for a downtown portion of Louisville, Kentucky, and a section of Fort Rucker, Alabama. The downtown Louisville demonstration project is tied directly to major buildings while the Fort Rucker demonstration project is tied to a dispersed subdivision of homes. The Louisville project shows a payback of approximately 3 y, while Fort Rucker is approximately 30 y. The primary difference is that at Fort Rucker new heat pumps are charged to the system. In Louisville, either new construction requiring heating and cooling systems or existing chillers are utilized. DOE

N80-24861# South Dakota School of Mines and Technology, Rapid City.
ENERGY FROM HUMID AIR Final Report
T. K. Oliver, W. N. Groves, C. L. Gruber, and A. Cheung Feb. 1979 99 p refs
(Contract EX-76-C-01-2553)
(DSE-2553-79/1) Avail: NTIS HC A05/MF A01

A cost effective process to convert the energy in humid air into mechanical work to drive an electrical generator was investigated using computer modeling. Results for a natural draft tower show that it is not a cost effective way to get energy from humid air. Parametric studies are presented for expansion-compression cycles. With suitable conditions, including large amounts of cooling during compression, this cycle has an attractive network output. To avoid using all the output power to overcome machine losses, it appears necessary to use a one-machine mechanization. The most promising uses vortex flow to achieve the necessary expansion and subsequent compression with cooling. Power output and costs were estimated for a vortex plant located in Puerto Rico. DOE

N80-24862# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
STANDARD ASSUMPTIONS AND METHODS FOR SOLAR HEATING AND COOLING SYSTEMS ANALYSIS
Cecile M. Leboeuf Jan. 1980 7 p refs Presented at the 2nd Ann. Systems Simulation and Econ. Anal. Conf., San Diego, Calif., 23-25 Jan. 1980
(Contract EG-77-C-01-4042)
(SERI/TP-351-548; CONF-800101-9) Avail: NTIS HC A02/MF A01

A set of inputs, assumptions, analytical methods, and a reporting format is presented to help compare the results of residential and commercial solar system analyses being performed by different investigators. For residential heating and cooling systems, three locations were selected. The weather data chosen to characterize these cities are the Typical Meteorological Year (TMY). A house for each location was defined that is typical of new construction in that locale. Hourly loads for each location were calculated using a computerized load model that interacts with the system specified inputs characterizing each house. Four locations for commercial cooling analyses were selected from among the existing sites for which TMYs were available. A light commercial (nominal 25 ton cooling load) office building was defined and is used in all four locations. Hourly cooling and heating loads were computed for each city. DOE

N80-24863# Franklin Research Center, Philadelphia, Pa.
HEAT-PUMP-CENTERED INTEGRATED COMMUNITY ENERGY SYSTEMS Final Report
Richard E. Crane and Robert G. Werden (Werden (R.G.) and Assoc., Philadelphia) Dec. 1979 223 p refs Supersedes ANL/ICES-TM-26
(Contract W-31-109-eng-38)
(ANL/CNSV-TM-24; ANL/ICES-TM-26-Rev) Avail: NTIS HC A10/MF A01

Heat-pumps-centered integrated community energy systems (HP-ICES) are energy systems for communities which provide heating, cooling and/or other thermal energy services through the use of heat pumps. Since heat pumps primarily transfer energy from existing and otherwise probably unused sources, rather than convert it from electrical or chemical to thermal form, HP-ICES offer significant potential for energy savings. Information is presented on the following: the HP-ICES concept; its application potential; variations in the basic HP-ICES concept which could lead to improved performance; applications of the concept to specific communities; design; economics; environmental impacts; and component testing requirements. DOE

N80-24864# Grumman Aerospace Corp., Bethpage, N.Y.
FURTHER INVESTIGATIONS OF DIFFUSER AUGMENTED WIND TURBINES. PART 1: EXECUTIVE SUMMARY Final Report
K. M. Foreman and B. L. Gilbert Jul. 1979 11 p
(Contract EY-76-C-02-2616)
(COO-2616-2-Pt-1-Rev-1) Avail: NTIS HC A02/MF A01

A multiphased experimental program is described which involves wind tunnel test facilities and models of several compact diffuser configurations. Screens to simulate a wind turbine and a three-bladed, fixed-pitch turbine were used with the diffuser models. A candidate baseline design is described, and some of the key technical and economic issues which can lead to future full scale implementation are discussed. DOE

N80-24865# Georgetown Univ., Washington, D.C. School of Engineering and Applied Science.
UTILITY RATE STRUCTURES AND DISTRIBUTED THERMAL ENERGY STORAGE: A COST/BENEFIT ANALYSIS Basic Research Report, Oct. 1978 - Feb. 1979
Evan F. Koening Feb. 1979 44 p refs
(Contract ET-78-S-01-3411)
(DSE-3411-T1) Avail: NTIS HC A03/MF A01

Three alternative methods by which electric utilities might take advantage of distributed thermal energy storage to smooth out their load profiles are examined. The three methods are: time-specific rates, time-invariant rates with subsidized storage, and direct load controls. The optimal form of each of these policies was determined, and formulas indicating the relative desirability of each policy were developed. DOE

N80-24868# General Electric Co., Schenectady, N. Y. Chemical Systems and Technology Lab.
THERMAL ENERGY STORAGE SUBSYSTEMS FOR SOLAR HEATING AND COOLING APPLICATIONS: ROLLING CYLINDER THERMAL STORAGE Interim Report
R. F. Thornton and C. S. Herrick Jun. 1979 119 p refs
(Contract EM-78-C-05-5759)
(ORO-5759-T1) Avail: NTIS HC A06/MF A01

The rolling cylinder provides a means for utilizing the latent heat of fusion of salt hydrates for thermal energy storage. Calorimetric tests of laboratory scale rolling cylinders using Glauber's salt have confirmed the technical feasibility of the concept. Several concepts for large scale, one million Btu units were evaluated for heat rate capability, blower and rolling power requirements, and relative cost and manufacturability. Large scale units seem technically and economically viable. The recommended size of the prototype is a two foot diameter, nine foot long cylinder of about 250,000 Btu theoretical capacity. DOE

N80-24867# Du Pont de Nemours (E. I.) and Co., Aiken, S. C.
SOLAR-POWERED ENVIRONMENTAL DATA COLLECTION SYSTEM
H. W. Randolph Feb. 1980 18 p
(Contract EY-76-C-09-0001)
(DP-1529) Avail: NTIS HC A02/MF A01

A solar powered system consisting of a multipurpose remote data collector, a radio data link, and a data receiving station was designed to acquire data from various remote areas at the Savannah River Plant. A prototype system was built to monitor gamma radiation at the plant perimeter. It is operating satisfactorily and will be installed to monitor gamma radiation or other environmental parameters at many remote locations on the plant. DOE

N80-24868# Oak Ridge National Lab., Tenn. Energy Div.
ENERGY AVAILABILITIES FOR STATE AND LOCAL DEVELOPMENT: 1975 DATA VOLUME
J. B. Mills, P. L. Rice, and D. P. Vogt Jan. 1980 285 p
(Contract W-7405-eng-26)
(ORNL/TM-6951) Avail: NTIS HC A13/MF A01

The supply, demand, and net imports of seven fuel types of four final consuming sectors for Bureau of Economic Analysis Areas (BEAs), states, census regions, and the nation in 1975 are presented. The data are formatted to present regional energy availability from primary extraction as well as from regional transformation processes. Extensive tables depict energy balances between availability and use for each specific fuel. A consistent base of historic and projected energy information is presented within a standard format. Such a framework should aid regional policy makers in their consideration of regional-growth issues that may be influenced by the regional energy system. For analysis of specific regions, however, this basic data should be supplemented by additional information which only the local policy analyst can bring to bear in his assessment of the energy conditions that characterize his region. DOE

N80-24869# Oak Ridge Associated Universities, Tenn. Inst. for Energy Analysis.
JAPAN: ESTIMATES OF FUTURE ENERGY/GNP RELATIONSHIPS IN ENERGY USE
J. A. Edmonds and Edward L. Allen Dec. 1979 95 p refs
(Contract EY-76-C-05-0033)
(ORAU/IEA-79-21(M)) Avail: NTIS HC A05/MF A01

As a consequence of continued rapid economic expansion, Japan's energy consumption is projected to more than double between 1976 and 2000. At the same time GNP is projected to triple, accompanied by lowering of the Japanese energy/GNP ratio by 30%. Industrial and transportation sector energy efficiency gains are expected to lead the way, with residential and commercial sector consumption growing almost abreast with GNP. The delayed home appliance revolution is expected to offset much of the gains from slow population growth. On the other hand, the Japanese automobile population explosion is expected to proliferate more energy-efficient automobiles throughout the economy, rapidly raising overall fleet performance. A significant shift toward water transport of freight also improves the overall performance of the transport sector. DOE

N80-24870# Department of Energy, Washington, D. C. Office of Analytical Sciences.
NATIONAL ENERGY PLAN 2, MAY 1979. APPENDIX A: WORLD OIL PRICES
1979 65 p refs
(DOE/TIC-10203-App-A) Avail: NTIS HC A04/MF A01

The detailed assumptions and projections used to develop the Second National Energy Plan (NEP-2) world oil price cases are presented in three major sections. The first section presents assumptions about potential world demand and production of oil, assuming constant real future world oil prices. Included is a discussion of alternative theories of OPEC behavior. The second section presents world oil price paths generated by mathematical models of world oil supply and demand. The models calculate oil prices that act through price elasticities to change the assumed constant-price oil demand and supply conditions to achieve a balanced oil market. The final section synthesizes the various model projections into the range of world oil price cases used in NEP-2 and reports major conclusions resulting from the world oil price analysis. DOE

N80-24871# Department of Energy, Washington, D. C. Office of Building and Community Systems.
ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS: ECONOMIC ANALYSIS
Jan. 1980 402 p
(DOE/CS-0129) Avail: NTIS HC A18/MF A01

The major economic impacts of the implementations of the standards on affected groups were assessed and the effectiveness of the standards as an investment in energy conservation was evaluated. The methodology used to evaluate the standards for the various building types and perspectives is described. The net economic effect of changes in building cost and energy use are discussed for three categories of buildings: single family residential, commercial and multifamily residential, and mobile homes. Forecasts of energy savings and national costs and benefits both with and without implementation of the standards are presented. The effects of changes in energy consumption and construction of new buildings on the national economy, including such factors as national income, investment, employment, and balance of trade are assessed. DOE

N80-24872# Royal Aircraft Establishment, Farnborough (England).
PROTON/ELECTRON DAMAGE RATIOS FOR SOME VIOLET, BLACK, AND THIN SILICON SOLAR CELLS
M. W. Walkden London HMSO Nov. 1979 72 p refs
(Contract ESTEC-3301/NL-77(HP))
(RAE-TR-79133; RAE-Space-571; BR71903) Avail: NTIS HC A04/MF A01

Proton damage ratios which relate the damage caused by protons of different energies to that caused by 1 MeV electrons were used to study radiation environment and other factors may affect solar cell output power. Four different types of modern silicon solar cells were subjected to 1 MeV electrons and protons in the energy range from 2 to 50 MeV followed at each irradiation stage by an exposure to photon irradiation. It was found that the proton damage ratio of one type of cell was approximately one half of that of the other three types and that the proton damage ratio for this type of cell was independent of temperature. One cause of these differences is attributed to photon induced changes in solar cell performance following electron and proton irradiation for the particular material from which this type of cell is made. Author (ESA)

N80-24873# National Bureau of Standards, Washington, D.C. National Engineering Lab.
EVALUATION OF ENERGY CONSERVING MODIFICATIONS FOR WATER HEATERS Final Report
Robert L. Palla, Jr. Jul. 1979 53 p refs
(PB80-133853; NBSIR-79-1783) Avail: NTIS HC A04/MF A01 CSCL 10A

The effects of various energy-conserving modifications on water heating energy consumption were evaluated based on laboratory tests. Nine storage-type residential water heaters, representative of standard and energy-saving electric gas, and oil fueled models currently on the market, were obtained for testing. Federally-promulgated water heat test procedures were

used to measure the energy consumption of each unit before and after modifications. GRA

N80-24874# New Mexico Energy Inst., Albuquerque.
PREPARATION OF HIGHLY EFFICIENT SOLAR CELLS AND CORROSION STUDIES ON SOLAR CELL MATERIALS Final Report, 1 Jul. 1978 - 30 Jun. 1979
Su-Moon Park Jul. 1979 69 p refs Sponsored by New Mexico Energy and Minerals Dept.
(PB80-141294; NMEI-46) Avail: NTIS HC A04/MF A01 CSCL 10B

The Pourbaix diagram was applied to the prediction and understanding of corrosion properties of semiconductor materials. With the aid of flat band potential information, the thermodynamic stability of semiconductor materials under various operating conditions, types of electrodes (n- or p-), conversion efficiencies, types of redox couples, and the proper operating pH-region can be determined. Electrolyte and pH dependencies of flat band potentials were studied to be able to design more efficient semiconductor-liquid junction solar cells. Various effects of electrolytes on flat band potentials were also studied. GRA

N80-24875# New Mexico Energy Inst., Albuquerque.
VARIABLE SPEED CONSTANT FREQUENCY VOLTAGE GENERATOR (ALTERNATOR) Final Report
W. W. Grannemann Jul. 1979 46 p refs Sponsored by New Mexico Energy and Minerals Dept.
(PB80-141286; NMEI-44) Avail: NTIS HC A03/MF A01 CSCL 10B

The objective achieved was constucting the first prototype alternator with digital control of its output frequency for a variable shaft speed, such as a wind machine would have. The first machine is a two-pole alternator with power removed from the rotor through slip rings. The rotating field in the stationary coils of the stator is controlled by the microcircuits. Later alternators may well have the control circuits and rotating field in the rotor which would be a significant improvement since power would not need to be removed through slip rings. Except for the power amplifiers which drive the stator windings, the control and the comparison circuitry is constructed with available low cost, low power integrated circuits (IC's). Test results from the first prototype demonstrate that the alternator can successfully convert available wind power directly to usable a-c 60 hertz power to supplement line power. The power generated by the alternator can have constant frequency as determined by the local power system and the control circuitry. Variations in the mechanical speed of rotation of the alternator rotor, which are caused by changes in wind velocity, will change the power output of the alternator while the voltage and the frequency remain constant. GRA

N80-24876# Bechtel National, Inc., San Francisco, Calif. Research and Engineering Dept.
PROJECTED ANNUAL RESOURCE REQUIREMENTS AT THE NATIONAL AND REGIONAL LEVEL FOR THE DEPARTMENT OF COMMERCE ENERGY FORECAST 1985 AND 2000
Andrea L. Watson and Ralph G. J. Zimmerman Mar. 1979 205 p Sponsored by Dept. of Commerce
(PB80-126956) Avail: NTIS HC A10/MF A01 CSCL 10A

An analysis is presented of the national and regional resource requirements (capital, material, manpower, etc.) associated with future energy development in the U.S. The analysis, using Bechtels Energy Supply Planning Model (ESPM) indicates projected cumulative capital requirements of $1.6 trillion (January 1978 dollars) during the 1977 - 2000 forecast period. The largest requirements by energy sector are for electric power generation facilities (53%) coal-fired plants in particular. Although the U.S. is projected to become more and more dependent upon western energy resources, both capital and labor requirements are projected to move from Western to Eastern regions - by the year 2000 - again primarily because of electrical generation requirements. GRA

N80-24877# National Bureau of Standards, Washington, D.C.
FIRE EXPERIMENTS AND FLASH POINT CRITERIA FOR SOLAR HEAT TRANSFER LIQUIDS Final Report
B. T. Lee and W. D. Walton Nov. 1979 42 p refs Sponsored in part by DOE
(PB80-140536; NBSIR-79-1931) Avail: NTIS HC A03/MF A01 CSCL 13A

To help provide a rational basis for developing flammability criteria for heat transfer fluids used in solar energy collection systems, fire tests were performed using simulated accident scenarios involving spills, flowing leaks, spray leaks, and soaked insulation. These experiments indicated that the flash point temperatures, as measured with the Pensky-Martens closed cup apparatus, are close to the minimum temperatures at which pools of the fluids will support a flame when they are exposed to a small pilot igniting flame in a room. The heat release from moderate sized burning pools of these liquids is sufficient to cause flashover in a room. Interim flash point critera of at least 28 deg C (50 deg F) greater than the maximum operating temperature and not more than 111 deg C (200 deg F) below the maximum no-flow temperature are proposed to reduce the risk of fire in the use of solar heat transfer liquids. GRA

N80-24878# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Civil Engineering.
SNOW AND ICE ACCUMULATION AROUND SOLAR COLLECTOR INSTALLATIONS Final Report
Michael J. ORourke Aug. 1979 75 p refs Sponsored in part by DOE
(Contract NB79-NAAA-6099)
(PB80-127053; NBS-GCR-79-180) Avail: NTIS HC A04/MF A01 CSCL 13A

Half the installations had the collectors mounted flush with the roof surface, while the remainder had collectors mounted on racks at an angle to the roof. Contours of snow depth on the roof, snow densities, measurements of snow on the ground adjacent to the building, sketches, and photographs of the roofs, and comments of the owners of the installations are included in addition to a discussion of the state of the art of predicting snow accumulation on roofs of buildings. The effect of solar collectors on the design of roof structures for the support of snow loads is discussed and recommendations for future research are made. GRA

N80-24879# Versar, Inc., Springfield, Va.
COMPARISON OF MODEL PREDICTIONS AND CONSUMPTIVE WATER USE OF CLOSED CYCLE COOLING SYSTEM Final Report, Mar. - Jul. 1978
Jerome B. Strauss Nov. 1978 207 p refs
(Contract EPA-68-02-2618)
(PB80-148273; EPA-600/7-78-206) Avail: NTIS MF A01 CSCL 13A

Results are presented of a comparison of field data-derived water evaporation rates with predictive model values for cooling towers and cooling ponds at steam-electric generating plants. The Leung Moore coolingtower model and five cooling pond models (Harbeck and Marciano; Harbeck; Harbeck, Koberg, and Hughes; Myer; and Brady et al.) were used in the study. Plant data from 13 utilities (16 cooling tower systems and 7 cooling ponds) and for 5 water resource regions were utilized. For the water resource regions included in the study, ponds generally exhibited higher consumptive water use than towers. GRA

N80-24893*# Los Alamos Scientific Lab., N. Mex.
POTENTIAL PREDICTION NEEDS IN SUPPORT OF ENERGY SYSTEMS
Richard L. Blake *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 198-202 ref Sponsored in part by DOE (For primary document see N80-24878 15-42)
Avail: NTIS HC A99/MF A01 CSCL 10B

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N80-24880*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
A STUDY OF POULTRY PROCESSING PLANT NOISE CHARACTERISTICS AND POTENTIAL NOISE CONTROL

TECHNIQUES Final Report
J. C. Wyvill, A. D. Jape, L. J. Moriarity, and R. D. Atkins 1980 170 p refs Sponsored in part by Georgia Dept. of Agr.
(Grant NsG-3228)
(NASA-CR-163139) Avail: NTIS HC A08/MF A01 CSCL 13B

The noise environment in a typical poultry processing plant was characterized by developing noise contours for two representative plants: Central Soya of Athens, Inc., Athens, Georgia, and Tip Top Poultry, Inc., Marietta, Georgia. Contour information was restricted to the evisceration are of both plants because nearly 60 percent of all process employees are stationed in this area during a normal work shift. Both plant evisceration areas were composed of tile walls, sheet metal ceilings, and concrete floors. Processing was performed in an assembly-line fashion in which the birds travel through the area on overhead shackles while personnel remain at fixed stations. Processing machinery was present throughout the area. In general, the poultry processing noise problem is the result of loud sources and reflective surfaces. Within the evisceration area, it can be concluded that only a few major sources (lung guns, a chiller component, and hock cutters) are responsible for essentially all direct and reverberant sound pressure levels currently observed during normal operations. Consequently, any effort to reduce the noise problem must first address the sound power output of these sources and/or the absorptive qualities of the room. R.E.S.

N80-24881*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VARIATION OF AIRCRAFT NOISE ANNOYANCE
Thomas K. Dempsey Apr. 1980 11 p refs Presented at the 99th Acoust. Soc. of Am. Meeting, Atlanta, 21-25 Apr. 1980
(NASA-TM-81804) Avail: NTIS HC A02/MF A01 CSCL 13B

Laboratory and field studies were conducted to determine the basis for increased sensitivity of people to noise during aircraft noise studies. This change in sensitivity could be attributed to either a physiological time-of-day effect (i.e., a circadian rhythm) or simply to the total number of aircraft noise events experienced during a laboratory test period. In order to investigate the time-of-day factor, noise sensitivity measures were obtained from subjects at home with cassette tape recorders/headsets over a 24 hour period. The effect of number of aircraft noise events on noise sensitivity was investigated within a laboratory. In these tests, measures of sensitivity to noise were obtained from subjects before and after their exposure to varying numbers of aircraft noise events. The 24 hour data showed no evidence that noise sensitivity is physiologically cyclical. Consequently, these data can not explain annoyance response variation to aircraft noise tests conducted during the daytime. However, the number of aircraft noise events did influence the subject's noise sensitivity. This effect completely accounts for the systematic increase in noise sensitivity during a laboratory test period. Author

N80-24882# Naval Postgraduate School, Monterey, Calif.
VALIDATION OF AN AMBIENT AIR QUALITY MODEL FOR NAVAL AIR OPERATIONS M.S. Thesis
Terry Scott Douglas Dec. 1979 133 p refs
(AD-A081768) Avail: NTIS HC A07/MF A01 CSCL 13/2

An initial validation of an Air Quality Assessment Model for Naval air operations was conducted at NAS Miramar, Calif. A previously developed model was updated to appropriately represent 1978-1979 operations and then evaluated for prediction sensitivity to variations in meteorological and dispersion model parameters. A joint effort with the Naval Air Propulsion Center, the Environmental Protection Agency/Northrup Services, Inc. and PMTC, Point Mugu was conducted to obtain detailed data over a one week period. Comparison of model predictions with the limited initial measured concentration data indicated that: (1) predicted CO concentrations were in good agreement with measurement; (2) predicted NOx concentrations from aircraft idle/taxi operations were too low; and (3) predicted total hydrocarbons and particulate concentrations were too high for aircraft idle/taxi operations and too low for environ sources. GRA

N80-24883# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 124: F104D AIRCRAFT, NEAR AND FAR-FIELD NOISE
Robert G. Powell Aug. 1979 88 p
(AF Proj. 7231)
(AD-A081845; AMRL-TR-75-50-Vol-124) Avail: NTIS HC A04/MF A01 CSCL 01/2

This volume provides measured and extrapolated data defining bioacoustic environments produced by this aircraft during ground runup operations. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with ground runups of the F-104D aircraft. This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft, ground support equipment, and other ground-based equipment or facilities. Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Volume 2 provides a method and data for adjusting the handbook:s far-field noise data, which are for standard meteorological conditions (15 C temperature, 70% rel humidity, 0.760 meters Hg barometric pressure), to derive comparable data for other meteorological conditions. Refer to Volumes 1 and 2 (references 1 and 2) for such information because it is not repeated in other handbook volumes. GRA

N80-24884# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
ENVIRONMENTAL CONTROL TECHNOLOGY FOR THE FLASH HYDROPYROLYSIS OF COAL Progress Report, 1 Apr. - 31 Dec. 1978
Feb. 1979 81 p refs
(Contract EY-76-C-02-0016)
(BNL-50983; PR-3) Avail: NTIS HC A05/MF A01

Based on experimental results and analytical studies, preliminary environmental and economic assessments of a conceptual, industrial scale FHP-Refinery Complex were made. Three cases were considered, one for the production of pipeline gas, the second for the production of liquid hydrocarbons such as motor gasoline and liquid prepared gas LPG, and the third for the production of both liquid and gaseous effluents for each case gaseous products. Solid, liquid and gaseous products. Solid, liquid and gaseous effluents for each case were evaluated, and required effluent treatment facilities and potential problem areas identified. Thermal efficiency range from 50% to 72%, depending upon the mode of operation of the Complex, and investment costs from 834 to 936 million dollars. The installed cost of environmental equipment is estimated at about 5% of total plant investment for all three cases. DOE

N80-24885# Oak Ridge National Lab., Tenn. Environmental Sciences Div.
ANALYSIS OF ENVIRONMENTAL IMPACTS OF WATER LEVEL FLUCTUATION IN RESERVOIRS AT HYDROELECTRIC SITES
A. T. Szluha, J. M. Loar, R. R. Turner, and S. G. Hildebrand 1979 8 p refs Presented at the Waterpower 79 Intern. Conf.: Small Scale Hydropower, Washington, D.C., 1 Oct. 1979
(Contract W-7405-eng-26)
(CONF-791056-2) Avail: NTIS HC A02/MF A01

Potential significance, on a site-specific basis, of water-level-fluctuation impacts ranges from begin (run-of-the river plants) to possibly significant enough to require mitigation. It is emphasized that efforts to develop small hydroelectric sites that entail water level fluctuation should include a careful analysis of the types of impacts. The potential significance of these impacts should be evaluated as an integral part of initial studies of site feasbility. DOE

N80-24886# Niagra Univ., New York, N.Y.
ENVIRONMENTAL CONSEQUENCES OF ATMOSPHERIC

KRYPTON-85 Final Report, 1 Jan. 1977 - 30 Sep. 1979
W. L. Boeck 1979 17 p refs
(Contract EE-77-S-02-4364)
(COO-4364-2) Avail: NTIS HC A02/MF A01

Krypton-85 is a radioactive inert gas produced during normal operations of the nuclear fuel cycle. The quantities of krypton-85, that will be produced in the next century, are sufficient, if released to alter the electrical state of the atmosphere. The principal hypothesis is that an anthropogenic alteration of the electric state of the atmosphere could alter other meterological phenomena and lead to significant environmental impacts. The goal was to explore some areas of basic science related to the evaluation of that hypothesis. The approach was primarily theoretical. The following topics were addressed: a first approximation model to estimate the effects of krypton-85 on the electrical state of the atmosphere; an analysis of the pathways between krypton-85 production and the atmosphere; an analytical model for fair weather atmospheric electricity; and a dipole model for atmospheric electricity. The results will provide a framework on which detailed models can be built. The results should provide better understanding of some topics in atmospheric electricity. DOE

N80-24887# California Univ., Livermore. Lawrence Livermore Lab.
POTENTIAL ENVIRONMENTAL EFFECTS OF AIRCRAFT EMISSIONS
F. M. Luther, J. S. Chang, W. H. Duewer, J. E. Penner, R. L. Tarp, and D. J. Wuebbles 15 Oct. 1979 233 p refs
(Contract W-7405-eng-48)
(UCRL-52861) Avail: NTIS HC A11/MF A01

An assessment is provided of the potential environmental effects of fleets of subsonic, supersonic, and hypersonic aircraft. A general discussion of photochemical and transport modeling techniques is included along with a description of the LLL one dimensional transport-kinetics model that was used in the assessment. Model simulations of the natural and perturbed stratosphere are used to compare theory with observations as a means of verification of model processes. A review is provided of engine emission indexes and 1990 fleet projections. Assessments of the potential effects of subsonic and supersonic aircraft fleets indicate a small increase in total ozone. However, the change in total ozone is the net difference between regions of ozone increase (in the lower stratosphere and upper troposphere) and ozone decrease (in the upper stratosphere). The percent change in the local ozone concentration is much larger than the change in total ozone. The effect of a proposed hydrogen fueled hypersonic transport fleet is a small reduction in total ozone. A study is made of the effect on these results of uncertainties in chemical rate coefficients, speculative chemical reactions, temperature feedback, hydrostatic adjustment, and various model parameters. The potential effect on ozone of aircraft emissions is compared with potential changes due to other anthropogenic perturbations. DOE

N80-24888# Brookhaven National Lab., Upton, N. Y. Process Sciences Div.
ENVIRONMENTAL CONTROL TECHNOLOGY FOR ATMOSPHERIC CARBON DIOXIDE
Meyer Steinberg and Anthony S. Albanese 1980 31 p refs Presented at the Intern. Workshop on the Energy/Climate Interactions, Munster, West Germany, 3-7 Mar. 1980
(Contract EY-76-C-02-0016)
(BNL-27164; CONF-800309-1) Avail: NTIS HC A03/MF A01

The impact of fossil fuel use in the United States on worldwide CO2 emissions and the impact of increased coal utilization on CO2 emission rates are assessed. The aspects of CO2 control are discussed as well as the available CO2 control points (CO2 removal sites). Two control scenarios are evaluated, one based on the absorption of CO2 contained in power plant flue gas by seawater; the other, based on absorption of CO2 by (mono ethanol amine-MEA). Captured CO2 is injected into the deep ocean in both cases. The analyses indicate that capture and disposal by seawater is energetically not feasible, whereas capture and disposal using MEA is a possibility. However, the economic penalties of CO2 control are significant. The use of nonfossil energy sources, such as hydroelectric, nuclear or solar energy is considered as an alternative for limiting and controlling CO2 emissions resulting from fossil energy usage. DOE

N80-24889# North American Weather Consultants, Goleta, Calif.
WORKSHOP ON ATMOSPHERIC DISPERSION MODELS IN COMPLEX TERRAIN Final Report, Mar. - Oct. 1979
Einar L. Hovind, Max W. Edelstein, and Victoria C. Sutherland Nov. 1979 215 p refs Workshop held in Raleigh, N.C., 16-20 Jul. 1979
(Contract EPA-68-02-3223)
(PB80-138571; EPA-600/9-79-041) Avail: NTIS HC A10/MF A01 CSCL 13B

Problems associated with plume dispersion modeling in complex terrain are addressed. Aspects of the topic discussed include environmental and control pollution technology, and industrial and scientific viewpoints. Model development, analysis, evaluation, and application are covered along with experimental design, measurement techniques, and data management and quality assurance. Recommendations are summarized. J.M.S.

N80-24890# Environmental Protection Agency, Research Triangle Park, N.C. Emission Standards and Engineering Div.
CONTROL TECHNIQUES FOR CARBON MONOXIDE EMISSIONS Final Report
Jun. 1979 410 p refs
(PB80-140510; EPA-450/3-79-006) Avail: NTIS HC A18/MF A01 CSCL 13B

This document characterizes carbon monoxide emission sources and controls for use by states in revising state implementation plans. It is intended for use by state and local air pollution control engineers to provide basic available information on carbon monoxide emissions from mobile sources, stationary combustion sources, and industrial process sources. Both demonstrated and feasible control strategies are presented for each source. Information is also provided on emission reduction benefits, energy requirements of controls, and annualized and operating costs of controls. GRA

N80-24891# Rhode Island Univ., Kingston. Dept. of Chemistry.
A RESONANCE RAMAN METHOD FOR THE RAPID DETECTION, IDENTIFICATION AND QUANTITATION OF BACTERIA IN SEWAGE AND NATURAL WATERS Completion Report, 1 Oct. 1977 - 30 Sep. 1979
Wilfred H. Nelson 1979 21 p refs Sponsored by Dept. of Interior
(PB80-138522; W80-03087; OWRT-B-078-RI(1)) Avail: NTIS HC A02/MF A01 CSCL 06M

Resonance Raman spectroscopy was used to rapidly identify and quantify chromogenic bacteria in water. A series of carotene-containing bacteria were studied using a standard Spex model 1401 spectrometer with a photon counting detection system. Line intensities and energies are presented. Two intense bands were found for each bacterial spectrum. A substantial number of the microorganisms produced specific, interpretable resonance Raman spectra. The spectra were simply obtained, of high quality, and are reproducible. The method will allow for the rapid identification of microorganisms in the presence of 'contaminants' such as sewage and water. GRA

N80-24892# Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
POLLUTION ASSESSMENT AND POTENTIAL MOBILITY OF HEAVY METALS IN GREAT LAKES SEDIMENTS Report, 1 Oct. 1978 - 30 Sep. 1979
Richard M. Owen Oct. 1979 29 p refs
(Contract DI-14-34-0001-9024)
(PB80-133580; W80-02704; OWRT-A-101-MICH(1)) Avail: NTIS HC A03/MF A01 CSCL 07D

A sequential extraction scheme was used to determine the geochemical fractionation of Fe, Mn, Cr, Cu, and Zn in different grain size classes for sediment samples collected from within and around Little Traverse Bay, Lake Michigan. The partitioning of Fe, Cr, and Cu in both sediment and presently eroding coastal bluff samples are similar. Also the concentrations of these metals in fine grained particles are not proportional to the increased surface area of these grains compared with larger grain sizes. Both of these results indicate that these metals have undergone little authigenic change since entering the lacustrine environment.

However, sediment Zn concentrations are significantly higher than in coastal bluff samples, and also have a different geochemical fractionation. In general, Mn shows relatively little mobility in the bay's oxizing environment, except in areas where Mn nodules are forming. GRA

N80-24893# California Univ., Riverside. Statewide Air Pollution Research Center.

CHEMICAL CONSEQUENCES OF AIR QUALITY STANDARDS AND OF CONTROL IMPLEMENTATION PROGRAMS: ROLES OF HYDROCARBONS, OXIDES OF NITROGEN, OXIDES OF SULFUR AND AGED SMOG IN THE PRODUCTION OF PHOTOCHEMICAL OXIDANT AND AEROSOL Final Report, 24 May 1977 - 30 Sep. 1978

James N. Pitts, Jr. Jun. 1979 167 p refs Sponsored by California Air Resources Board

(PB80-126840; ARB-R-A6-172-30-79-104) Avail: NTIS HC A08/MF A01 CSCL 97D

Using an environmental chamber, the reactivity scale of the reaction of organic compounds with the OH radical was studied. Investigations were carried out in order: (1) to establish correlations between ozone formation and hydroxyl radical rate constraints and hydrocarbon reactivity scales; (2) to determine rate constants for the reactions of hydroxyl radicals with selected organic compounds including alkanes, alkenes and alkene oxides; (3) to obtain data concerning the rates of conversion of sulfur dioxide to sulfate aerosol under simulated atmospheric conditions; (4) to extend the previous oxidant-HC-NO(x) data base by generating data for 12 hour irradiation experiments employing both constant light intensity and quasi-diurnal light intensity; and (5) to apply both computer kinetic modeling and an emperical mathematical approach to assessments of oxidant-precursor relationships. GRA

N80-24894# Battelle Columbus Labs., Ohio.

ASSESSMENT OF DIESEL PARTICULATE CONTROL: DIRECT AND CATALYTIC OXIDATION Final Report, Mar. - Jul. 1979

M. J. Murphy, L. J. Hillenbrand, and D. A. Trayser Oct. 1978 33 p refs

(Contract EPA-68-02-2629)

(PB80-128697; EPA-600/7-79-232B) Avail: NTIS HC A03/MF A01 CSCL 13B

The technology and potential for disposal of diesel particulate by oxidation are discussed. Relevant properties of typical diesel particulate are given; note is taken of the small size (on the order of 0.1 micrometer diameter) and the presence of a portion extractable with an organic solvent. Available reaction rate data is used to derive particle lifetimes at various temperatures; these exceed likely exhaust system residence times. The use of catalysts to increase oxidation rates and lower ignition temperatures is discussed. Small amounts of many metals are effective in increasing the rate of oxidation by 2 to 5 orders of magnitude. Chemical reactor theory is used to derive ignition and operational characteristics of trap/oxidizers. Note is also taken of the tendency of these devices to go rapidly from a cold unignited state to an ignited state close to the adiabatic flame temperature of the fuel. Design techniques to ameliorate undesirable temperature excursions are presented. GRA

N80-24895# Maine Univ., Orono. Land and Water Resources Center.

A SIMPLE POLLUTION VULNERABILITY INDEX FOR PRELIMINARY COASTAL WATER QUALITY MANAGEMENT PLANNING

Bruce J. Edwards and Franklin E. Woodard Oct. 1979 32 p refs Sponsored by Office of Water Res. and Technol.

(PB80-134323; W80-02768; OWRT-A-047-ME(1)) Avail: NTIS HC A03/MF A01 CSCL 13B

A quantitative pollution vulnerability index was developed for locating future coastal discharge in Maine so that deleterious effects are minimized. The index is designed to serve as a planning tool for agencies in coastal zone management. The vulnerability of a coastal zone is determined by its capacity to accept a particular pollutant which is a function of dispersion, background pollutant levels, and allowable limits. The Weyl 'pollution susceptibility index' is used because it is mathematically simple and requires minimal input data. Because levels of critical use are not well defined for a wide range of pollutants, fecal coliform is used for an example. GRA

N80-24896# Tennessee Valley Authority, Chattanooga. Power Research Staff.

DESIGN OF A MONITORING PROGRAM FOR ASH POND EFFLUENTS Final Report, May 1975 - Apr. 1979

F. A. Miller, III, T. V. J. Chu, and R. J. Ruane Nov. 1979 207 p refs Sponsored by EPA

(PB80-128457; PRS-41; EPA-600/7-79-236) Avail: NTIS HC A10/MF A01 CSCL 13B

A procedure is described for designing an effective monitoring program for fossil-fueled power plant ash pond effluents. Factors that influence effluent characteristics and are important in designing such a monitoring program were determined following a review of plant operating characteristics and ash pond effluent characteristics of TVA's fossil-fueled power plant system. A statistical procedure for determining the sampling frequency of chemical characteristics in ash pond effluents precision are described: method 1 involves selecting a precision value to estimate the population mean within a given percentage; method 2 involves calculating a precision value by subtracting an estimate of the population mean from either the ash pond effluent limitation established by EPA or a desirable water quality criterion. Method 2 gives the number of samples required to show that the effluent is in compliance with the effluent limitation or below the water quality criteria. The method chosen to compute the precision depends on the purpose of the monitoring program. The procedure was demonstrated for two TVA ash pond systems. GRA

N80-24897# Southern Research Inst., Birmingham, Ala.

ASSESSMENT OF DIESEL PARTICULATE CONTROL: FILTERS, SCRUBBERS, AND PRECIPITATORS Final Report, Mar. - Jul. 1979

M. G. Faulkner, E. B. Dismukes, J. R. Donald, D. H. Pontius, and A. H. Dean Oct. 1979 177 p refs

(Contract EPA-68-02-2610)

(PB80-128655; SORI-EAS-79-564; EPA-600/7-79-232A; Rept-3858-14-FR) Avail: NTIS HC A09/MF A01 CSCL 13B

An investigation is reported of three types of devices that might be used for the after-treatment of diesel exhaust to lower particulate emmissions form light-duty vehicles. The devices are filters, electrostatic precipitators (ESPS), and wet scrubbers. The conclusions reached are that filters and ESPs merit further consideration but wet scrubbers do not. Wet scrubbers were eliminated from further consideration on the basis of excessive size, low efficiency, and excessive fluid loss by evaporation (assuming that water is the fluid of choice). Filters and ESPs, although appearing to offer significant potential, have possible disadvantages that can only be assessed experimentally. Prototype filters and electrostatic devices that appear worthy of experimental study are described. GRA

N80-24898# Rockwell International Corp., Newbury Park, Calif. Air Monitoring Center.

QUALITY ASSURANCE IN SUPPORT OF ENERGY RELATED MONITORING ACTIVITIES Annual Report

Mark Cher Jun. 1979 69 p refs

(Contract EPA-68-02-2412)

(PB80-135270; AMC-8303.135-AR-2; EPA-600/7-79-136; AR-2) Avail: NTIS HC A04/MF A01 CSCL 13B

A program to establish a quality assurance data base for ambient air monitoring around present and proposed energy development projects, and to provide technical assistance to enable existing monitoring networks to achieve a high level of data quality is described. Results from laboratory performance surveys carried out for the analysis of sulfate, nitrate, SO2, NO2, and CO and for weight measurements and high volume flow rate are given. GRA

N80-24899# Rockwell International Corp., Creve Couer, Mo. Environment Monitoring and Services Center.

DOCUMENTATION OF THE REGIONAL AIR POLLUTION STUDY (RAPS) AND RELATED INVESTIGATIONS IN THE SAINT LOUIS AIR QUALITY CONTROL REGION Final Report

Joseph A. Strothmann and Francis A. Schiermeier Dec. 1979

717 p refs
(Contract EPA-68-02-2093)
(PB80-138241; EPA-600/4-79-076) Avail: NTIS
HC A99/MF A01 CSCL 13B

During the period of 1974 to 1977, the regional air pollution study (RAPS) was conducted in the St. Louis, Missouri/Illinois metropolitan area. Because of the availability of extensive monitoring data, additional independent research studies were conducted in the St. Louis area during this time frame. This report is an attempt to document nearly all the RAPS and related investigations conducted in the St. Louis air quality control region during the period of 1973 to 1978. Descriptions of locally operated air quality and meteorological networks are also included. Such a report will serve as a summary of data available to the EPA modelers in pursuit of the RAPS objectives and will be used by RAPS researchers to locate supplementary data sources to augment their own measurements. GRA

N80-24900# Radian Corp., Austin, Tex.
CALCIUM SULFITE CRYSTAL SIZING STUDIES Final Report
Larry O. Edwards Aug. 1979 97 p refs Prepared for EPA, Washington, D.C.
(Contract EPA-68-02-2608)
(PB80-128689; EPA-600/7-79-192) Avail: NTIS
HC A05/MF A01 CSCL 13B

A reliable experimental method is described that can be used routinely to determine the crystal size distribution function, a measure that is required for a mathematical representation of the nucleation and growth processes involved in the settling, dewatering, and disposal of calcium sulfite sludge from lime/limestone or dual alkali scrubbers, a major problem associated with coal burning. Optical and instrumental crystal sizing methods were compared and the merits of each discussed; Coulter counting is recommended. GRA

N80-24901# National Transportation Policy Study Commission, Washington, D. C.
TRANSPORTATION AND THE ENVIRONMENT
Elaine M. Conley May 1979 63 p refs
(PB80-133812; NTPSC/WP-79-14) Avail: NTIS
HC A04/MF A01 CSCL 13B

Major issues and concerns of transportation as they relate to environmental and safety goals were studied. A number of particularly important or timely issues in the context of transportation, the environment, and safety over the next 25 years are treated. Eight issues were selected according to several qualitative criteria, in consultation with experts in the field, Commission regional public hearings, and current literature. They were selected to represent a sampling of acute and chronic problems in the provision of transportation supply affecting all the modes. GRA

N80-24902# IIT Research Inst., Chicago, Ill.
HOUSTON URBAN PLUME STUDY, 1974. MICROSCOPICAL IDENTIFICATION OF COLLECTED AEROSOLS Interim Report, Jul. 1974 - Oct. 1977
Ronald G. Draftz and Jean Graf Sep. 1979 62 p refs
(Grant EPA-R-803078)
(PB80-139074; EPA-600/3-79-090) Avail: NTIS
HC A04/MF A01 CSCL 13B

An urban plume study was conducted in Houston during July 1974 to gain preliminary data on the concentration and composition of primary and secondary aerosols contributing to Houston's air pollution problem. Selected membrane filter samples containing urban aerosols were analyzed by polarized light and scanning electron microscopy to identify the aerosols and their possible sources. The aerosol samples, collected by aircraft at elevations from 1,000 to 4,000 feet above sea level, consisted principally (more than 95 percent by number) of mineral silicate fragments. A trace to minor quantity of carbonaceous particles (resembling diesel exhaust), lead bromide compounds (from vehicle exhausts), and sea salt were also found in most samples. No discrete particles of ammonium sulfate were present. GRA

N80-24903# Environmental Sciences Research Lab., Research Triangle Park, N.C.
PHOTOCHEMISTRY OF SOME NATURALLY EMITTED HYDROCARBONS
Robert R. Arnts and Bruce W. Gay, Jr. Sep. 1979 140 p refs
(PB80-131980; EPA-600/3-79-081) Avail: NTIS
HC A07/MF A01 CSCL 04A

Six C10H16 monoterpenes, p-cymene, and isoprene, all known or thought to be emitted to the atmosphere by vegetation, were irradiated in the presence of NOx. The terpenes studied included one acyclic triolefin (myrcene), two monocyclic diolefins (d-limonene, terpinolene), and three bicyclic monolefins (alpha-pinene, beta-pinene, and delta-carene). Propylene was also studied since this olefin serves as a point of reference with other chamber studies. Results show that monoterpenes and isoprene promoted the oxidation of NO to NO2 and were themselves consumed at rates comparable to or greater than propylene; p-cymene was decidedly slow in these respects. The monoterpenes however did not permit the buildup of ozone due to their rapid reaction with ozone. The ozone suppression was particularly noticeable at high carbon/NOx ratios. Deciduous forests, isoprene emitters, are coniferous forests. Coniferous forests may in fact function as a sink for ozone. Reported ambient concentrations of isoprene and terpenic hydrocarbons in forested areas are too low to account for more than a few ppb of ozone even if NOx is available.GRA

N80-24904# Environmental Monitoring and Support Lab., Las Vegas, Nev.
A BATTERY-OPERATED AIR SAMPLER FOR REMOTE AREAS Final Report
K. W. Brown, G. B. Wiersma, and C. W. Frank Nov. 1979 16 p refs
(PB80-128978; EPA-600/4-79-071) Avail: NTIS
HC A02/MF A01 CSCL 14B

An air sampling system developed to evaluate air quality in biosphere reserves or in other remote areas is described. The equipment consists of a Dupont P-4000 pump and a specially designed battery pack containing Gates batteries. This air sampling system was tested in southern Utah and at 10 remote sampling sites in the Great Smoky Mountains National Park. The equipment was backpacked to the remote sampling sites, and was operated continuously at full capacity for a maximum 8 day period. Except for tampering by curious hikers at one site, the equipment operated satisfactorily. GRA

N80-24905# San Jose State Univ., Calif. Dept. of Meteorology.
OBSERVATIONAL PROGRAM FOR AIR POLLUTION MODELS Final Report
Peter F. Lester Apr. 1979 27 p ref
(Contract ARB-A7-180-30)
(PB80-139298; ARB-R/79-101) Avail: NTIS
HC A03/MF A01 CSCL 04B

PIBAL winds and aircraft soundings of temperature, moisture, oxidant, and particulates were gathered at several locations in the San Francisco Bay area and in the Northern Salinas Valley during the period July 31 through August 17, 1978. The observational program was conducted during MABLES WC, an extensive field study of the marine boundary layer. The design of the experiment, schedule of observations and resulting data are described. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N80-24906* National Aeronautics and Space Administration. Pasadena Office, Calif.
GEOLOGICAL ASSESSMENT PROBE Patent
Earl R. Collins, inventor (to NASA) (JPL) Issued 8 Apr. 1980 8 p Filed 25 Sep. 1978 Supersedes N80-12642 (18 - 3, p 0365) Sponsored by NASA
(NASA-Case-NPO-14558-1; US-Patent-4,196,619; US-Patent-Appl-SN-945436; US-Patent-Class-73-155) Avail: US Patent and Trademark Office CSCL 08G

A probe is described which can be installed in a side hole

that extends from a bore hole in the Earth, to assess the permeability of the strata surrounding the borehole. The probe is elongated and has a plurality of seals spaced therealong and sealed to the walls of the side hole to form a plurality of chambers sealed from one another. A tracer fluid injector on the probe can inject a tracer fluid into one of the chambers, while a tracer fluid detector located in another chamber can detect the tracer fluid, to thereby sense the permeability of the strata surrounding the side hole. The probe can include a train of modules, with each module having an inflatable packer which is inflated by the difference between the borehole pressure and the strata pressure. Official Gazette of the U.S. Patent and Trademark Office

N80-24907 Pennsylvania State Univ., University Park.
EFFECT OF TRANSFORMATION OF SUPERPLASTIC PROPERTIES WITHIN THE OLIVINE-SPINEL TRANSITION ZONE OF THE EARTH'S MANTLE Ph.D. Thesis
James Lindall Dain 1979 200 p
Avail: Univ. Microfilms Order No. 8010045

A theory for transformational superplasticity (TSP) is derived and applied to geophysical situations involving the olivine-spinel transformation. An internal stress mechanism is assumed, in which internal stresses resulting from transformational volume change interact with an applied stress to trigger pseudo-Newtonian behavior in an intrinsically non-Newtonian material. Theoretical analysis shows that the internal stress TSP can probably occur in the 400 km transition zone under appropriate circumstances. The pressure-change rates used in conjunction with published data on the olivine-spinel transformation give transformation rates ranging from 10 to the - 13th power s (-1) to 10 to the -15th power s (-1). Assuming a strain rate of 10 to the -15th power s (-1) consistent with plate tectonics, the theory predicts that the high transformation rate probably can, and the low transformation rate probably cannot, induce TSP. Application of the theory to a simple model of transformation in subducted lithosphere indicates the possibility that the seismicity gaps found over broad depth ranges centered on a depth of 400 km may be related to TSP stress relaxation. Dissert. Abstr.

N80-24908 State Univ. of New York at Stony Brook.
CARIBBEAN TECTONIC PROCESSES: SEISMIC SURFACE WAVE SOURCE AND PATH PROPERTY ANALYSIS Ph.D. Thesis
Alan Louis Kafka 1980 294 p
Avail: Univ. Microfilms Order No. 8011075

The magnitude threshold for earthquake focal mechanism and depth studies was lowered as far as mb = 4.7 by exploiting the surface wave portion of seismograms recorded at Worldwide Standardized Seismic Station Network stations. The initial phase was calculated and the Rayleigh wave phase velocities between the events and the observing stations were determined. A plane layered, laterally homogeneous, oceanic Earth model for the source region in the theoretical Rayleigh wave calculations was assumed, as well as the introduction of a subducting lithospheric slab. The tectonic implications of these focal mechanism results remain independent of the Earth model chosen for the source region. The focal mechanisms determined for the northeastern Caribbean plate boundary indicate that this displacement is at present accommodated along this boundary by a complex oblique subduction process. The mechanisms determined for the southern Caribbean plate boundary and the intra-Caribbean plate region indicate this displacement is being accommodated over a broad zone of internal deformation which extends from northern South America into the interior of the Caribbean plate. Dissert. Abstr.

N80-24909 Stanford Univ., Calif.
ATTENUATION OF SEISMIC WAVES IN ROCKS AND APPLICATIONS IN ENERGY EXPLORATION Ph.D. Thesis
Einar Kjartansson 1980 160 p
Avail: Univ. Microfilms Order No. 8011658

The absorption and dissipation of seismic wave energy into heat is examined. A mathematical description for the general elastic response and wave propagation in materials where the specific loss or Q factor is exactly independent of frequency is developed. One particular mechanism for the dissipation of energy, thermal relaxation, is examined. This mechanism, which affects compressional waves more than shear waves, is highly sensitive to the state and the nature of the pore fluids. Wave propagation in media where attenuation and velocity are spatially heterogeneous is also discussed. Finite difference solutions to the wave equation are developed to include the effects of absorption, as well as arbitrary spatial heterogeneities. Finally, methods are developed to extract information about spatial variations of attenuation and velocities from seismic reflection data. The application of the inversions to amplitude and traveltime data from unstacked common-midpoint reflection data yield detailed pictures of the subsurface. Dissert. Abstr.

N80-24910 Stanford Univ., Calif.
DETAILED SEISMIC STUDIES OF SIX MODERATE CALIFORNIA EARTHQUAKES Ph.D. Thesis
Allan Goddard Lindh 1980 185 p
Avail: Univ. Microfilms Order No. 8011665

Material velocity changes, reported to precede the last two magnitude-5 earthquakes along the San Andreas fault in central California, are shown to be caused by differences in the depth and magnitude of the source earthquakes during the anomalous periods and unrelated to any premonitory material property changes. Additional data show that travel times before the two magnitude-5 earthquakes were in fact stable to within a few hundredths of a second for rays that passed within a few kilometers of the hypocenters. The ratio of the amplitudes of P and S waves from fore- and aftershocks to three recent California earthquakes show a characteristic change at the time of the main events, inferring a small systematic change in stress or fault configuration in the source region. An approach to the recognition of foreshocks based on simple measurements of the amplitudes of seismic waves is suggested. Correlations with regional geology suggest that fault discontinuities, determined through examination of data pertaining to the 1966 Parkfield, California earthquake, are controlled by changes in material properties along the fault. Dissert. Abstr.

N80-24911 Colorado Univ. at Boulder.
THE DIURNAL EVOLUTION OF THE EAST AFRICAN JET STREAM Ph.D. Thesis
David Marc Rubenstein 1979 201 p
Avail: Univ. Microfilms Order No. 8011302

The diurnal evolution of the equatorial east African low level jet stream is examined theoretically and observationally. Using measurements taken aboard a research aircraft, the turbulent fluxes of heat and momentum are computed. Profiles of these fluxes are used to descriptively analyze the diurnal behavior of the mesoscale jet structure. During the daytime, as the flow advects from a suppressed marine environment to an actively convective continental environment, a mixed layer grows in depth. A nonlinear entrainment model is developed to describe the evolution of the mixed layer in both time and space. During the evening a stable layer builds up and causes the pre-existing mixed layer to erode. Frictional restraint falls dramatically, allowing a strong jet to develop during the night. A linear analysis suggests that the development is the result of an imbalance between the pressure gradient force and friction. A diurnally periodic circulation transverse to the mean jet axis responds to the heating cycle over the land. This transverse circulation results from a combination of a slope-induced breeze and a sea breeze. These effects are simulated by a linear, buoyancy driven diffusion model.
Dissert. Abstr.

N80-24912 Brown Univ., Providence, R. I.
MORPHOMETRIC STUDIES OF PLANETARY LANDFORMS: IMPACT CRATERS AND VOLCANOES Ph.D. Thesis
Charles Arthur Wood 1979 230 p
Avail: Univ. Microfilms Order No. 8007089

Impact craters and basins on Mars, Mercury, and the Moon are comparatively examined and the morphometry of three types of volcanoes (composite, nonbasaltic shield volcanoes, and cinder cones) are investigated. Cinder cone growth rates vary from cone to cone with time for a single cone. Cinder/spatter cones on Reunion and Etna grow slowly, whereas the Tolbachik cones and Vulcan grew to hundreds of meters in a few days. For 16 cones there is a statistically significant relation between average cone growth rate and ultimate cone volume. There is a strong positive correlation between cone volume and flow volume. Cinder cones have smaller volumes than their association flows, and commonly a lesser volume than associated mantle ash deposits.

The effects of degradation on cone morphometry were investigated in detail. Cinder cones on the Moon and Mars have W sub CR/W sub CO ratios nearly identical to terrestrial values, but are only 25% to 35% as tall as Earth cones. Extraterrestrial cinder cones are roughly 25% the volume of terrestrial cones, suggesting shallower magma source areas than typical on Earth. Dissert. Abstr.

N80-24913 Institut d'Aeronomie Spatiale de Belgique, Brussels.
OPEN ION-EXOSPHERE WITH AN ASYMMETRIC ANISOTROPIC VELOCITY DISTRIBUTION
M. Scherer 1979 36 p refs Presented at 7th Roy. Acad. of Belgium Session, Brussels, Oct. 1978 Submitted for publication
(Aeronomica-Acta-A-205-1979) Avail: Issuing Activity

Expressions for the number density, the escape flux, the parallel and perpendicular momentum fluxes, and the energy flux in an open ion-exosphere, are set up under the following assumptions: (1) the velocity distribution function at the exobase is given by an an asymmetric bimaxwellian depending on four parameters; and (2) along a magnetic field line the potential energy of a charged particle is a monotonic function while the magnetic field strength monotonically decreases to a constant value. A method which allows for calculating the four parameters of the velocity distribution for a given set of values of the state variables is outlined. Finally, the analytic formulas for the state variables are explicitely given for the special case that the velocity distribution at the exobase is a bimaxwellian. Author (ESA)

N80-24914*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPARISON OF THE NIMBUS-4 BUV OZONE DATA WITH THE AMES TWO-DIMENSIONAL MODEL
W. J. Borucki and I. J. Eberstein May 1980 46 p refs Prepared in cooperation with NASA, Goddard Space Flight Center
(NASA-TM-81207; A-8139) Avail: NTIS HC A03/MF A01 CSCL 04A

A comparison is made of the first two years of Nimbus 4 backscattered ultraviolet (BUV) ozone measurements with the predictions of the Ames two dimensional model. The ozone observations used consist of the mixing ratio on the 1, 2, 5, and 10 mb pressure surfaces. The data are zone and time averaged to obtain seasonal means for 1970 and 1971 and are found to show strong and repeatable meridional and seasonal dependencies. The model used for comparison with the observations extends from 80 N to 80 S latitude and from altitudes of 0 to 60 km with 5 deg horizontal grid spacing and 2.5 km vertical grid spacing. Chemical reaction and photolysis rates are diurnally averaged and the photodissociation rates are corrected for the effects of scattering. The large altitude, latitude, and seasonal changes in the ozone data agree with the model predictions. Model predictions of the sensitivity of the comparisons to changes in the assumed mixing ratios of water vapor, odd nitrogen, and odd chlorine, as well as to changes in the ambient temperature and transport parameters are also shown. E.D.K.

N80-24915*# Minnesota Univ., Minneapolis. Cosmic Physics Group.
A STUDY OF PARTICLE ACCELERATION MECHANISMS AND DYNAMICS OF THE OUTER TRAPPING REGION BY OBSERVATIONS AT SYNCHRONOUS ORBIT: A SUMMARY OF SCIENTIFIC RESULTS
K. N. Ericlson Feb. 1980 69 p refs
(Contract NAS5-11687; NAS5-23703)
(NASA-CR-159979; Cosmic-Phys-TR-184) Avail: NTIS HC A04/MF A01 CSCL 04A

The research concerning the ATS-6 synchronous orbit satellite is reported. The completed research and results are discussed along with the research in progress. Abstracts of published papers are included. F.O.S.

N80-24916# Lowell Univ. Research Foundation, Mass. Center for Atmospheric Research.
MEASUREMENT OF NEUTRAL TEMPERATURE IN THE 120-180 KM REGION OF THE ATMOSPHERE FOLLOWING TMA RELEASES FROM A ROCKET Final Technical Report, 17 Jan. 1977 - 17 Aug. 1978
David F. Kitrosser Hanscom AFB, Mass. AFGL May 1979 75 p refs
(Contract F19628-77-C-0090; AF Proj. 2310)
(AD-A081445; ULRF-403/CAR; AFGL-TR-79-0120) Avail: NTIS HC A04/MF A01 CSCL 07/4

Atmospheric temperature measurement at approximately 160 km altitude over White Sands Missile Range on 24 September 1977 were made by the AlO sunlit resonance fluorescence technique. A rocket borne payload released trimethyl aluminum (TMA) in one large cloud at morning twilight. Twelve minutes of data were used to calculate temperatures at the top of the cloud averaging 628 K and at bottom averaging 578 K. The standard deviation of any one measurement involving typically 40 seconds of data was generally between 5 and 11 K. Included in this report is the most detailed description to date of the procedures and statistical background underlying the 'AlO Temperature' technique developed by the author over the last eleven years. GRA

N80-24917# Air Force Geophysics Lab., Hanscom AFB, Mass.
LINEAR FILTERING ON THE SURFACE OF A SPHERE Environmental Research Papers
Ralph Shapiro 29 Oct. 1979 33 p refs
(AF Proj. 2310)
(AD-A082386; AFGL-TR-79-0263; AFGL-ERP-683) Avail: NTIS HC A03/MF A01 CSCL 04/1

Although methods of filtering have been developed for representing on a planar surface the sub-grid scale process of diffusion in numerical modeling of the atmosphere, the proper form of filtering for a spherical domain remains to be selected. In this study, the characteristics of several different forms of a highly scale dependent low pass filter are examined and compared for the case where the filter is applied to a scalar field on the surface of a sphere. The phase and amplitude response functions of the various forms of the filter indicate that the simplest form, although it does not preserve area-weighted mean values, approaches most closely the criteria established for the ideal filter. This indication is verified by the test computations in which each form of the filter is applied up to 10,000 times to a noisy scalar field. GRA

N80-24918# Air Force Geophysics Lab., Hanscom AFB, Mass. Space Physics Div.
PROCEEDINGS OF THE AIR FORCE GEOPHYSICS LABORATORY WORKSHOP ON GEOMAGNETISM
Rita C. Sagalyn, Robert O. Hutchinson, and Susan Gussenhoven 20 Aug. 1979 128 p refs Workshop held at Hanscom AFB, Mass., 6-7 Apr. 1979
(AF Proj. 7601)
(AD-A082308; AFGL-TR-79-0192; AFGL-SR-223) Avail: NTIS HC A07/MF A01 CSCL 04/1

On 6-7 April 1979 a two-day workshop on geomagnetism was held at the Air Force Geophysics Laboratory (AFGL). Proceedings of the workshop presented here include: reports on tutorial sessions concerning magnetospheric and geomagnetic pulsations, summaries of contributed papers, descriptions of active magnetometer networks, conclusions of workshop-discussion groups. Special emphasis is given to the use and future potential of the AFGL midlatitude magnetometer chain. GRA

N80-24919# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Meteorology Office.
AUTOMATED MODEL ATMOSPHERE GENERATOR PROGRAM (AMAG) Final Report, 10 Oct. 1977 - 31 Oct. 1979
Edward H. Blish Feb. 1980 71 p refs
(AD-A082088; ASD-TR-79-5056) Avail: NTIS HC A04/MF A01

This paper documents a computer program for generating internally consistent model atmosphere data based on a terrain following five layer temperature model derived from the 1976 U.S. Standard Atmosphere and the 1966 U.S. Standard Atmosphere Supplements. For any given geometric altitude, terrain height, ground level temperature and altimeter setting, the Automated Model Atmosphere Generator (AMAG) program will calculate corresponding temperature and pressure altitude values. From these two output parameters the user can compute additional

environmental parameters needed to solve particular engineering problems. GRA

N80-24820# Florida Inst. of Tech., Melbourne. Dept. of Physics and Space Sciences.
SATELLITE PARTICLE OBSERVATIONS AND COINCIDENT AURORAL-E IONIZATION Final Report, 1 Jun. 1978 - 31 Aug. 1979
James R. Sharber 31 Oct. 1979 70 p refs
(Grant AF-AFOSR-3625-78; AF Proj. 2311)
(AD-A082121; AFOSR-80-0173TR) Avail: NTIS HC A04/MF A01 CSCL 04/1

Using data taken during coordinated flights of the AFGL Airborne Ionospheric Observatory and the ISIS-2 Satellite, a comparison has been made between the particle spectrum of the continuous (diffuse) aurora and the properties of the auroral-E region with the following results: Most electron differential number spectra of the diffuse aurora may be represented as Maxwellians with characteristic energy between a few hundred eV to a few keV; this characteristic energy increases with the pitch angle to a maximum value of 90. Over the diffuse aurora, the angular distribution of electron energy flux is isotropic only near the peak of precipitation. At latitudes above and below the peak, the energy flux at the edge of the loss cone may exceed that near the local field line by as much as a factor of two. Integration of individual spectra over the loss cone produces a composite Maxwellian distribution which may be used to estimate the electron energy deposited in the E-region. The procedure underestimates the energy by about 20%. Although the continuous (diffuse) aurora is a relatively stable phenomenon, enhancements in intensity of the incident electrons occur on a time scale of a few seconds. It has not been determined whether these variations represent temporal or spatial changes. Within the energy range 10 eV to 15 keV the electron population accounts for 80 - 90% of the particle energy deposited into the E-region. GRA

N80-24821# Boston Coll., Chestnut Hill, Mass. Dept. of Physics.
STUDY OF CHARACTERISTICS OF POLAR CAP AURORAS IN DMSP IMAGES Final Report, 1 Oct. 1978 - 31 Dec. 1979
M. S. Gussenhoven 29 Feb. 1980 56 p refs
(Grant AF-AFOSR-0012-79; AF Proj. 2311)
(AD-A082184; AFOSR-80-0214TR) Avail: NTIS HC A04/MF A01 CSCL 04/1

Energetic electron measurements from a particle detector on the DMSP/F2 satellite have been used to determine the corrected geomagnetic latitude (Lambda sub CGM) of the equatorward boundary of the auroral oval. The satellite was launched into a nearly sun-synchronous, polar orbit centered on the 0700-1900 MLT meridian. Due to the wobble of the dipole and a very slow precessional motion of the orbit more than 6000 boundary crossings could be studied in the 1600-2300 and 0400-1000 MLT sectors. The detectors, which have large geometric factors, look radially away from the earth and detect precipitating electrons with energies between 50eV and 20keV. In the evening sector the equatorward boundaries are precisely determined from the rise in the total electron flux. The morningside boundary cannot always be clearly delineated. Data were divided into one hour magnetic local time bins with about 400 samples per bin. In each of the MLT bins Lambda sub CGM was found to be linearly correlated to the Kp index. Regression values of Lambda sub CGM were projected to the magnetic equatorial plane using the Mead-Fairfield magnetic field model. The projected boundaries are not in good agreement with the injection boundaries of Mauk and McIlwain. GRA

N80-24822# Texas A&M Univ., College Station. Dept. of Meteorology.
NONLINEAR TRANSFER OF KINETIC ENERGY IN THE ATMOSPHERE USING ONE AND TWO DIMENSIONAL SPECTRAL REPRESENTATION Final Report
Dusan Djuric 18 Feb. 1980 18 p refs
(Grant AF-AFOSR-3492-78; AF Proj. 2310)
(AD-A082069; AFOSR-80-0159TR) Avail: NTIS HC A02/MF A01 CSCL 04/1

A review of the literature on nonlinear transfer of kinetic energy in the atmosphere using one and two dimensional spectral techniques is presented. The numerical programs for the conversion of energy have been written and tested. It was found that the hemispheric meteorological data from the AFGWC and from ETAC have serious gaps that hinder the progress of nonlinear kinetic energy transfer calculations. It is suggested to introduce an interpolation technique which will formally fill the data gaps, or, alternatively, to acquire new data sets without such gaps. Energy transfer calculations can then be successfully completed. GRA

N80-24823# SRI International Corp., Menlo Park, Calif.
ON THE SPATIAL RELATIONSHIP OF 1-METER EQUATORIAL IRREGULARITIES AND DEPLETIONS IN TOTAL ELECTRON CONTENTS Topical Report, 1 Nov. 1978 - 31 Jan. 1979
Roland T. Tsunoda 1 Feb. 1980 27 p refs
(Contract DNA001-79-C-0153)
(AD-A082185; AD-E000684; DNA-4897T; Rept-1) Avail: NTIS HC A03/MF A01 CSCL 04/1

A radar experiment was conducted at Kwajalein Atoll, Marshall Islands to investigate the spatial relationship of 1 m equatorial spread-F irregularities to total electron content (TEC) depletion. A high-power radar was operated (1) in a backscatter scan mode to spatially map the distribution of 1 m irregularities, and (2) in a dual-frequency, satellite-track mode to obtain the longitudinal TEC variations. Using the radar data, we show that radar backscatter 'plumes' found in the disturbed, nighttime equatorial ionosphere are longitudinally coincident with TEC depletions. We suggest that the TEC depletions are probably due to the presence of plasma bubbles in the equatorial F layer. GRA

N80-24824# Scripps Institution of Oceanography, La Jolla, Calif. Visibility Lab.
AIRBORNE MEASUREMENTS OF ATMOSPHERIC VOLUME SCATTERING COEFFICIENTS IN NORTHERN EUROPE, WINTER 1978 Interim Report
Richard W. Johnson and Jacqueline I. Gordon Jun. 1979 298 p refs
(Contract F19628-78-C-0200; AF Proj. 7670)
(AD-A082044; SIO-REF-79-25; AFGL-TR-79-0159; SR-10) Avail: NTIS HC A13/MF A01 CSCL 04/1

This report presents daytime atmospheric optical data collected chiefly with airborne instruments during a field expedition to northern Europe in the Winter of 1978. Results from 26 flights are presented. The data include the natural irradiance upon horizontal plane surfaces, total volume scattering coefficients, and derived values of atmospheric beam transmittance and equivalent attenuation length. Data for daytime conditions ranging from relatively clear and cloud free to completely overcast are presented. Data were measured in four spectral regions, as follows: Three narrow band optical filters with mean wavelengths of 478, 664, and 765 nanometers; and one broad band representing a pseudo-photopic response with a mean wavelength of 557 nanometers. Selected meteorological properties, measured concurrently with the radiometric data are also included. GRA

N80-24825# Naval Research Lab., Washington, D. C. Geophysical and Plasma Dynamics Branch.
NONLINEAR STABILIZATION OF THE CURRENT CONVECTIVE INSTABILITY IN THE DIFFUSE AURORA
P. K. Chaturvedi (Maryland Univ., College Park) and S. L. Ossakow 7 Jan. 1980 18 p refs Sponsored in part by DNA
(AD-A082300; AD-E000378; NRL-MR-4118) Avail: NTIS HC A02/MF A01 CSCL 04/1

The current convective instability has recently been proposed as a possible mechanism for generating large scale irregularities in the auroral F region, driven by weak field-aligned currents associated with the diffuse aurora and a plasma density gradient (Ossakow and Chaturvedi, 1979). In this report, we show that this instability can stabilize nonlinearly by generating linearly damped harmonics. An estimate of the saturated amplitudes show good agreement with the available experimental data. In addition, with a northward plasma density gradient, the dominant nonlinear harmonic is in the northward direction, in agreement with DNA Wideband satellite observations. GRA

N80-24926# Meteorology International, Inc., Monterey, Calif.
THE APPLICATION OF MEASURES OF SYNOPTIC SIMILARITY TO THE EVALUATION AND DEVELOPMENT OF ATMOSPHERIC PREDICTION MODELS: TASK 2
Manfred M. Holl, Michael J. Corning, and Barbara A. Hawkins Feb. 1980 46 p refs
(Contract N00228-78-C-3258)
(AD-A082031; MII-M-247; NEPRF-CR-79-01-Supp) Avail: NTIS HC A03/MF A01 CSCL 04/1

This Report, the final report for Task 2 of the overall development of the MOSS (Measures of Synoptic Similarity) system, has been written as a Supplement to the final report for Task 1. Familiarity with and access to that report is assumed. The expanded MOSS system resulting from performance of Task 2 is known as MOSS2. Task 2 objectives were to extend the MOSS1 system to provide the MOSS2 system by incorporating the following additional features and capabilities: A capability for producing MOSS scores for the southern hemisphere; A capability for utilizing User-specified range-level values; A capability for matching, in ranges-of-scale, either 1000 mb fields only or 500 mb fields only, and for matching fields which have been pattern-separated prior to input to the MOSS2 system; A capability for producing an areal distribution of match coefficients for the SV, SL and SD ranges-of-scale at 500 mb, 1000 mb, and/or the 500-1000 mb thickness; A capability for producing an areal distribution of match coefficients which are a User-weighted combination of the SV, SL and SD ranges-of-scale; A capability for displaying the results of the MOSS2 system in tabulated form. GRA

N80-24927# Pennsylvania State Univ., University Park. Dept. of Meteorology.
THE ROLE OF DIABATIC HEATING IN GENERATING LOWER TROPOSPHERIC MESOCALE CIRCULATIONS Final Report, 23 Feb. 1976 - 31 Dec. 1979
Thomas T. Warner, Richard A. Anthes, and Nelson L. Seaman Dec. 1979 105 p refs
(Contract DAAG29-76-C-0157; Grant EPA-R-805659)
(AD-A082129; ARO-13817.1-GSX) Avail: NTIS HC A06/MF A01 CSCL 04/2

A two dimensional, multilevel primitive equation model is used to investigate various characteristics of thermally driven circulations. The sensitivity of the mesoscale circulations to the magnitude of the surface, sensible heat flux is established through examination of various quantifiable circulation features such as the planetary boundary layer depth and the horizontal and vertical wind maxima. The simulations fall into two groups; one deals with circulations over flat terrain in the vicinity of a coastline and the other deals with circulations induced by heating of the irregular terrain in the vicinity of the Tennessee Valley. The results establish a surprisingly linear relationship between forecast errors and errors in the specification of the surface sensible heat flux. The results of the Tennessee Valley simulations are verified using satellite visible imagery. The model-predicted subsidence over the valley corresponds very closely in location to anomalous cloud free regions observed in numerous satellite photographs. GRA

N80-24928# Utah Univ., Salt Lake City. Center for Atmospheric and Space Sciences.
ENERGY INPUT TO THE AURORAL IONOSPHERE Final Report, 1 Sep. 1977 - 31 Aug. 1978
J. R. Doupnik 29 Feb. 1980 69 p refs
(Grant AF-AFOSR-3435-77)
(AD-A083038; AFOSR-80-0261TR) Avail: NTIS HC A04/MF A01 CSCL 04/1

This effort was to aid studies of the high latitude ionosphere particularly with regard to Joule heating processes. For energy input to the atmosphere by Joule heating the dominant physical factor has been found to be the strength of the electric field; the motions of the ionospheric plasma through the nearly stationary neutral gas. Both the conductivity and electric field change by large factors but the dependence of the Joule heating rate on the square of the electric field strength makes the electric field the most critical factor. In the design of the experiments with a steerable dish antenna the conductivities are obtained from electron densities in the E region of the ionosphere while the electric fields are obtained from the F region. In this work, to cover a wide range of latitudes with acceptable time resolution, the E region measurements were curtailed. A suggestion from model studies is that the offset of the geomagnetic pole from the geographic pole and a further offset of the center of the oval to be several degrees antisunward of the geomagnetic pole introduces a strong longitudinal variation in the magnetic latitude of the oval. So, some longitude sectors, such as Chatanika, penetrate more deeply into the oval than other locations with the same magnetic latitude. GRA

N80-24929# Smithsonian Astrophysical Observatory, Cambridge, Mass.
CALCULATIONS PERTAINING TO THE ENERGY BALANCE AND PLASMA MOTIONS IN THE IONOSPHERE Final Report, 1 Jan. - 30 Sep. 1978
Alexander Dalgarno and Eustratios Constantinides Hanscom AFB, Mass. AFGL Nov. 1979 143 p refs
(Contract F19628-78-C-0047; AFGL-TR-79-0270)
(AD-A083010; AFGL-TR-79-0270) Avail: NTIS HC A07/MF A01 CSCL 04/1

Plasma motions in the upper atmosphere have been investigated with the aid of satellite data. It is shown that the major ion, O(+), moves in response to the sum of the forces on itself and on electrons. Major ions follow the motion of the major ion. The observed plasma velocity in the vertical direction is in harmony with the assumption of an eastward electric field of between 3 and 5 millivolts per meter. The present investigation demonstrates clearly the need for measurements of electric fields and plasma drifts. Author (GRA)

N80-24930# Cincinnati Univ., Ohio. Dept. of Physics.
THEORETICAL INVESTIGATION OF THE EFFECTS OF ATMOSPHERIC GRAVITY WAVES ON THE HYDROXYL EMISSIONS OF THE ATMOSPHERE Final Report, 15 Jul. 1978 - 30 Nov. 1979
Tai-Fu Tuan Hanscom AFB, Mass. AFGL 31 Dec. 1979 44 p refs
(Contract F19628-78-C-0208)
(AD-A083025; AFGL-TR-80-0007) Avail: NTIS HC A03/MF A01 CSCL 04/1

The effect of gravity waves on OH emission is investigated using a gravity-wave model valid for an inhomogeneous atmosphere and computed as well as semi-empirical data for the 'undisturbed' ozone and hydrogen profiles. The results show that (1) the magnitude of the response depends on the relative magnitudes and signatures of the vertical and horizontal wave-induced diffusion. Since in some regions the horizontal velocity field of the gravity wave can increase much more rapidly with height than the vertical field, horizontal diffusion even when there is a relatively sharp layer gradient; and (2) the structures in the OH profile produced by the gravity wave are in general but not always more pronounced below the intensity peak than above. The observed dark areas in OH emission can be produced by gravity waves with vertical wave length small compared with the half width of the intensity profile. GRA

N80-24931# Science Applications, Inc., La Jolla, Calif. Environmental Systems Div.
PROCEEDINGS OF THE HEAVY LIFT LAUNCH VEHICLE TROPOSPHERIC EFFECTS WORKSHOP
Arnold I. Goldford Dec. 1979 115 p refs Workshop held at Rosemont, Ill., 12-14 Sep. 1979
(Contract W-31-109-eng-38)
(CONF-7809192) Avail: NTIS HC A06/MF A01

A workshop on Heavy Lift Launch Vehicle (HLLV) tropospheric effects was held in Chicago, Illinois, on September 12, 13, and 14, 1978. Briefings were conducted on the latest HLLV configurations, launch schedules, and proposed fuels. The geographical, environmental, and ecological background of three proposed launch sites were presented in brief. The sites discussed were launch pads near the Kennedy Space Center (KSC), a site in the southwestern United States near Animus, New Mexico, and an ocean site just north of the equator off the coast of Ecuador. A review of past efforts in atmospheric dynamics modeling, source term prediction, atmospheric effects, cloud rise modeling, and rainout/washout effects for the space shuttle tropospheric effects indicated that much of the progress made in these areas has direct applicability to the HLLV. A list of

specific recommendations for short and long term research to investigate, understand, and possibly mitigate the HLLV environmental impacts was developed. DOE

N80-24932# Los Alamos Scientific Lab., N. Mex. Theoretical Div.

APPLICATION OF THE ADJOINT METHOD IN ATMOSPHERIC RADIATIVE TRANSFER CALCULATIONS

S. A. W. Gerstl 1979 20 p refs Presented at the Workshop on Atmospheric Aerosols: Their Formation, Optical Properties and Effects, Baltimore, 6-8 Nov. 1979

(Contract W-7405-eng-36)

(LA-UR-80-17; CONF-791161-1) Avail: NTIS HC A02/MF A01

The transfer of solar radiation through a standard mid-lattitude summer atmosphere including different amounts of aerosols (from clear to hazy) has been computed. The discrete-ordinates (S/sub N/) method is employed in a forward as well as adjoint mode. In the adjoint mode the result of a transfer calculation is an important function (adjoint intensity) which allows the calculation of transmitted fluxes or other radiative responses, for any arbitrary source distribution. The theory of the adjoint method is outlined in detail and physical interpretations are developed for the adjoint intensity. If, for example, the downward directed solar flux at ground level, F/sub lambda/ (z = 0), is desired for N different solar zenith angles, a regular (forward) radiative transfer calculation must be repeated for each solar zenith angle. In contrast, only 1 adjoint transfer calculation gives F/sub lambda/ (z = 0) for all solar zenith angles in a hazy aerosol atmosphere, for 1 wavelength interval, in 2.3 seconds on a CDC-7600 computer. DOE

N80-24933# Hawaii Univ., Honolulu. Inst. of Geophysics.

HYDROLOGY AND GEOCHEMISTRY OF A HAWAIIAN GEOTHERMAL SYSTEM: HGP-A Geothermal Resources Exploration in Hawaii no. 4

P. M. Kroopnick, R. W. Buddemeier, D. Thomas, L. S. Lau, and D. Sills Aug. 1979 69 p refs Revised

(Contract EY-76-C-03-1093; Grant NSF GI-38319)

(HIG-78-6-Rev) Avail: NTIS HC A04/MF A01

A water quality monitoring program of the Hawaii Geothermal Project well A (HGP-A) was conducted for downhole depth samples and continuous discharge samples in 1976 to 1977. The well water was slightly saline (about 5 to 10 percent ocean water) and nearly depleted of magnesium, but contained high concentrations of silica and sulfide. The chemical composition of the well water did not vary much with depth even though the sampling reached the well bottom (approximately 1768 m below sea level. The well fluid temperature was higher than that of any Hawaii ground water; a maximum of 358 C was recorded at the bottom of the well. The water was low in tritium but unexpectedly high in carbon-14 when compared with the surrounding ground water (sampled as close as approximately 1609 km away). Mass balance calculations involving carbon and its isotopes are consistent with a model proposing that 13 per cent of recharge is from sea water. During continuous flow tests, the total well yield was 83,400 lb of steam per hour, equivalent to approximately 150 gpm with 70 per cent steam and the rest water. For most constituents measured, there was a one to three day buildup period before approach to a steady state concentration. Water quality data, coupled with other measurements, indicate that the well is either poorly developed or located in a formation of low transmissivity. The moderately high rainfall and high surficial permeability allow substantial rain water infiltration. Actual subsurface water circulation is open to interpretation because of our uncertainty about geologic formations. Geophysical evidence suggests that deep dikes or intrusive bodies may be located on the ocean side of the well; such barriers would retard the encroachment of sea water into the well. DOE

N80-24934# Royal Aircraft Establishment, Farnborough (England).

UPPER-ATMOSPHERE ROTATION RATE DETERMINED FROM THE ORBIT OF CHINA 6 ROCKET (1976-87B)

H. Hiller London HMSO Sep. 1979 24 p refs

(RAE-TR-79115; RAE-Space-567; BR71447) Avail: NTIS HC A02/MF A01

The orbit of China 6 rocket, 1976-87B, was determined at 51 epochs during its 17 month life using the Royal Aircraft Establishment orbit refinement computer program, PROP 6, with over 4,000 radar and optical observations from 49 stations. On the average, the orbital accuracy was about 100 meters, radial and cross track. The rotation rate of the upper atmosphere and lambda rev/day, for the height-band 200 to 230 km, was calculated from the decrease in orbital inclination (after being cleared of perturbations) and the results are given. Values of density scale height were obtained from the variation in perigee height, including several values during the final 16 days to decay. Comparison with CIRA 1972 values shows agreement, mostly within 10 percent. Author (ESA)

N80-24935# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.

RESULTS FROM MAGNETOSPHERIC ELECTRIC FIELD OBSERVATIONS

Ulf Fahleson Mar. 1979 18 p refs Presented at Intern. Workshop on Selected Topics of Magnetospheric Phys., Tokyo, 12-16 Mar. 1979

(TRITA-EPP-79-04; ISSN-0348-7539) Avail: NTIS HC A02/MF A01

The results of magnetospheric dc and low frequency electric field measurements obtained to date by the GEOS, ISEE and S3 satellites are given. These cover the morning, noon, evening, and midnight sectors inside the magnetosphere both during quiet and disturbed (substorm) conditions. Indications are that near the dayside magnetopause large fluctuations occur even during relatively quiet times. Author (ESA)

N80-24936# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.

ON THE CONSEQUENCES OF THE INTERACTION BETWEEN THE AURORAL PLASMA AND THE GEOMAGNETIC FIELD

Walter Lennartsson May 1979 35 p refs Submitted for publication Sponsored in part by Swedish Board for Space Activities

(Contract N00014-78-C-0479)

(TRITA-EPP-79-16) Avail: NTIS HC A03/MF A01

An attempt to find a unified description of auroral electric fields based on the interaction between a hot plasma and the Earth's magnetic field is extended. It is shown that a large electrostatic potential difference must exist along the magnetic field lines under very general conditions as a direct consequence of this interaction. This does not require anomalous resistivity and is not a consequence of anisotropic pitch-angle distributions, but the electric field always produces anisotropy. In general, the electric field has a time-varying (unstable) spatial structure. An important source of temporal fluctuations is charge trapping in the combined electric and magnetic fields which is an inevitable effect of scattering. A necessary condition for a stable electric field structure to form is that this trapping saturates. The conditions for this are most favorable in a thin double layer structure, in particular one that is aligned along the magnetic field. A secondary effect of charge trapping is a collimation of the electron precipitation flux. Another effect consists of increasing the transverse energy of cold ions. This effect is particularly strong for oxygen, resulting in a conical pitch-angle distribution. Author (ESA)

N80-24937# Research Inst. of National Defence, Stockholm (Sweden).

A SEISMIC ACTIVITY DETECTOR

Paul Mitlid Nov. 1979 18 p

(FOA-C-20327-E4) Avail: NTIS HC A02/MF A01

A seismic activity detector is described. It is specially adapted to gainranging seismometer amplifiers. To facilitate long time constants, the reference voltage generating circuit employs a digital potentiometer. The reference voltage is linearly related to the background noise over the detector's entire working range. The bandpass filter has plug-in frequency determining units for easy change of cut-off frequencies. A method for identifying interesting seismic signals is discussed in relation to this equipment. Author (ESA)

N80-24938# Research Inst. of National Defence, Stockholm (Sweden).
INTERNATIONAL SEISMOLOGICAL DATACENTER: DEMONSTRATION FACILITIES IN SWEDEN
Ola Dahlman Jan. 1980 28 p refs
(FOA-C-20333-T1) Avail: NTIS HC A03/MF A01

To facilitate the establishment of an international global seismological monitoring system for the verification of a comprehensive Test Ban Treaty, Sweden offered to establish and operate an International Seismological Data Center. Temporary data center facilities were set up at the Hagfors Observatory of the National Defence Research Institute in Stockholm to demonstrate the feasibility of such a center. These facilities were demonstrated in July, 1979, to representatives and experts from 26 countries and the World Meteorological Organization. A general description of the demonstration facilities and a summary of the experience gained so far from these facilities are given.
Author (ESA)

N80-24680*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MODELING THE EARTH'S RADIATION BELTS. A REVIEW OF QUANTITATIVE DATA BASED ELECTRON AND PROTON MODELS
J. I. Vette, M. J. Teague, D. M. Sawyer, and K. W. Chan *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 21-35 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24681*# Air Force Geophysics Lab., Hanscom AFB, Mass.
LOW ENERGY MAGNETOSPHERIC PLASMA INTERACTIONS WITH SPACE SYSTEMS: THE ROLE OF PREDICTIONS
H. B. Garrett *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 36-70 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24682*# Aerospace Corp., Los Angeles, Calif. Space Sciences Lab.
PREDICTABILITY OF UPPER-ATMOSPHERIC DENSITY AND COMPOSITION
Joe M. Straus and David R. Hickman *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 71-88 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24686*# Rockwell International Corp., Houston, Tex.
DOSIMETRY IN THE MANNED SPACE PROGRAM
William Atwell *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 121-132 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

N80-24704*# California Univ., Los Angeles. Dept. of Earth and Space Sciences.
ON THE PREDICTION OF MAGNETOSPHERIC CONFIGURATION
James A. Slavin and Robert E. Holzer *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 365-374 refs (For primary document see N80-24678 15-42)
(Grants NGR-05-007-276; NSF ATM-75-01431)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24706*# National Oceanic and Atmospheric Administration, Boulder, Colo.
REVIEW OF SELECTED GEOMAGNETIC ACTIVITY INDICES
Joe H. Allen and J. Feynman (Boston Coll.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 385-398 refs (For primary document see N80-24678 15-42)
(Contract F19628-79-C-0031)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24707*# Air Force Geophysics Lab., Hanscom AFB, Mass.
THE PREDICTION OF AE, ap, AND Dst AT TIME LAGS BETWEEN 0 AND 30 HOURS
D. F. Smart, H. B. Garrett, and M. A. Shea *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 399-414 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24709*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHORT TERM MAGNETOSPHERIC PARTICLE VARIATIONS (1 MINUTE < T < 1 DAY). APPENDIX 1
P. R. Higbie (LASL), D. N. Baker (LASL), V. Domingo (European Space Technol. Center., Noordwijk, Netherlands), W. L. Imhof (LMSC, Palo Alto, Calif.), R. L. McPherron (California Univ., Los Angeles), W. N. Sojdvik (NOAA, Boulder, Colo.), D. J. Williams (NOAA, Boulder, Colo.), J. R. Burrows (Herzberg Inst. of Astrophysics), M. Hayakawa (Nagoya Univ.) et al *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 433-440 (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24710*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LONG TERM MAGNETOSPHERIC PARTICLE VARIATIONS (1 DAY < T < INFINITY). APPENDIX 2
J. I. Vette, H. K. Hills, G. A. Paulikas (Aerospace Corp., Los Angeles, Calif.), D. A. Sawyer, E. G. Stassinopoulos, M. J. Teague et al *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 441-445 (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24711*# Max-Planck-Institut fuer Extraterrestrische Physik, Munich (West Germany).
ENERGETIC SOLAR PARTICLE BEHAVIOUR IN THE MAGNETOSPHERE
M. Scholer *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 446-463 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24712*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A REAL-TIME ISEE DATA SYSTEM
Bruce T. Tsurutani and Daniel N. Baker (LASL) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 464-475 refs Sponsored in part by DOE (For primary document see N80-24678 15-42)
(Contract NAS7-100)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24713*# SRI International Corp., Menlo Park, Calif.
MAGNETOSPHERE-IONOSPHERE INTERACTIONS
R. R. Vondrak, Y. T. Chiu (Aerospace Corp., Los Angeles, Calif.), D. S. Evans (NOAA, Boulder, Colo.), V. G. Patterson (AF Global Weather Central), G. J. Romick (Alaska Univ., College), and K. Stasiewicz (Polish Acad. of Science, Warsaw) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 476-493 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24714*# Aerospace Corp., Los Angeles, Calif. Space Sciences Lab.
AURORAL MAGNETOSPHERE-IONOSPHERE COUPLING: A BRIEF TOPICAL REVIEW
Y. T. Chiu, J. M. Cornwall (California Univ., Los Angeles), and Michael Schulz *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 494-512 refs (For primary document see N80-24678 15-42)
(Contract NASw-3120)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24715*# Alaska Univ., College. Geophysical Inst.
HIGH-LATITUDE E AND F REGION IONOSPHERIC PREDICTIONS

Robert D. Hunsucker, R. Allen, P. Argo, R. Babcock, P. Bakshi, D. Lund, S. Matsushita, G. Smith, A. V. Shirochkov, and G. Wortham *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 513-527 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24716*# Arkticheskii i Antarkticheskii Nauchno- Issledovatelskii Institut, Leningrad (USSR).
ON THE APPROACH TO FORECASTING POLAR IONOSPHERIC CONDITIONS
A. S. Besprozvanneya, A. V. Shirochkov, and T. I. Shchuka *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 528-542 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24717*# Alaska Univ., Fairbanks. Geophysical Inst.
MORPHOLOGY AND PHENOMENOLOGY OF THE HIGH-LATITUDE E AND F REGIONS
Robert D. Hunsucker *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 543-561 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24718*# National Telecommunication Information Administration, Boulder, Colo. Inst. of Telecommunications Sciences.
REPORT OF THE MID- AND LOW-LATITUDE E AND F REGION WORKING GROUP
Charles M. Rush *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 562-572 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24719*# Norwegian Defence Research Establishment, Kjeller. Electronics Div.
D REGION PREDICTIONS
E. V. Thrane, D. K. Chakrabarty (Phys. Res. Lab.), S. D. Deshpande (Dept. of Appl. Phys., Coll. of Eng., India), R. H. Doherty (Colo. Res. and Prediction Lab.), J. B. Gregory (Saskatchewan Univ.), J. K. Hargreaves (Lancaster Univ.), J. Lastovicka, Peter Morris (Coast Guard, Washington, D.C.), W. R. Piggott (British Antarctic Surv.), and J. B. Reagan (LMSC, Palo Alto, Calif.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 573-598 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

N80-24720*# Air Force Geophysics Lab., Hanscom AFB, Mass.
ION PRODUCTION IN THE D REGION
William Swider *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 599-616 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04A

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N80-24939 Colorado State Univ., Fort Collins.
INTERNAL STORM MOTIONS FROM A SINGLE NON-DOPPLER WEATHER RADAR Ph.D. Thesis
Ronald Earl Rinehart 1979 281 p
Avail: Univ. Microfilms Order No. 8010834

A correlation analysis pattern recognition technique called TREC (Tracking Radar Echoes by Correlation) with developed which is capable of determining motions within storms. The success of TREC depends upon the interrelationships between the flow and reflectivity field characteristics as well as the parameters of TREC processing such as the array size and spacing and the data resolution. A comparison of TREC results with data from a triple Doppler radar system collection data at the same time on the same storm shows that TREC vectors are apparently generated either above or below the level being examined. While the average difference between the height of TREC vectors and Doppler data of best agreement was only 550 m, the standard deviation of this difference was 1.8 km. This is likely the most severe restriction on the use of TREC in deep convective storms. Dissert. Abstr.

N80-24940*# Arizona State Univ., Tempe. Coll. of Engineering and Applied Science.
WAKE CHARACTERISTICS OF BUILDINGS IN DISTURBED BOUNDARY LAYERS Final Report
Earl Logan, Jr. and Jingfa Chang May 1980 52 p refs
(Contract NASB-32357)
(NASA-CR-3284; M-298) Avail: NTIS HC A04/MF A01 CSCL 04B

Measurements relevant to the effect of buildings on the low level atmospheric boundary layer are presented. Field measurements of velocity and turbulence in the wake of a block building 3.2 m high and 26.8 m long are presented which show an apparent increase in momentum flow above the upwind value. Velocity-deficit and turbulence-excess decay characteristics of the disturbed or nonequilibrium layer are correlated with power law exponents and apparent roughness length at various distances downstream of the disturbance. Model wake profiles from the simulated building are compared at various stations for equilibrium and nonequilibrium upstream profiles. Empirical correlations relating building wake profiles to upstream nonequilibrium parameters are presented. The relationship of the data to the smooth-rough transition is discussed, and a flow model is presented. R.E.S.

N80-24941# National Research Inst. for Oceanology, Stellenbosch (South Africa). Physical Oceanography Div.
USE OF METEOSAT IN SOUTHERN OCEAN OCEANOLOGY AND SOUTHERN HEMISPHERE METEOROLOGY
Jre Lutjeharms Jun. 1979 30 p refs Presented at the ESA Conf. on Meteosat Usage, Darmstadt, West Germany, Jun. 1979
(CSIR-SEA-7918; ISBN-0-7988-1557-4) Avail: NTIS HC A03/MF A01

The use of Meteosat data in the refinement of weather prediction, determination of wind vectors, investigations on thunderstorms, the tracking of pollution plumes as well as in studies on the flooding of river mouths, on the water flux in and out of large lakes, and on the behaviour of ocean currents and ocean upwelling phenomena is briefly discussed. The placement of a drifting buoy in the south Atlantic Ocean using hourly thermal infrared images is also described. Some of the advantages and shortcomings of the data for oceanologic research are pointed out. M.G.

N80-24942# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
SMOOTHING AND FILTERING IN NUMERICAL WEATHER PREDICTION
H. A. Riphagen Jun. 1979 27 p refs
(CSIR-TWISK-87) Avail: NTIS HC A03/MF A01

A review is presented of various filtering and smoothing operators that may be used to control the spurious growth of high frequency components introduced by roundoff, truncation, observational errors, etc. The effects of these operators are discussed and illustrated by showing the result of their application in a three level simplified linear balanced weather prediction model. M.G.

N80-24943*# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
INTERACTIONS BETWEEN CONVECTIVE STORMS AND THEIR ENVIRONMENT Final Report
R. A. Maddox, L. R. Hoxit, and C. F. Chappell May 1979 104 p refs
(NASA Order S-40336-B)
(NASA-CR-159981) Avail: NTIS HC A06/MF A01 CSCL 04B

The ways in which intense convective storms interact with their environment are considered for a number of specific severe storm situations. A physical model of subcloud wind fields and vertical wind profiles was developed to explain the often observed

intensification of convective storms that move along or across thermal boundaries. A number of special, unusually dense, data sets were used to substantiate features of the model. GOES imagery was used in conjunction with objectively analyzed surface wind data to develop a nowcast technique that might be used to identify specific storm cells likely to become tornadic. It was shown that circulations associated with organized meso-alpha and meso-beta scale storm complexes may, on occasion, strongly modify tropospheric thermodynamic patterns and flow fields. R.E.S.

N80-24944*# Systems and Applied Sciences Corp., Hampton, Va.
SEVERE STORMS FORECAST SYSTEMS Final Report
M. Kaplan and J. Zack May 1980 8 p
(Contract NAS1-15680)
(NASA-CR-159282) Avail: NTIS HC A02/MF A01 CSCL 04B

Two research tasks are described: (1) the improvement and enhancement of an existing mesoscale numerical simulation system, and (2) numerical diagnostic studies associated with an individual case of severe storm development (April 10, 1979 in the Red River Valley of Texas and Oklahoma). R.E.S.

N80-24945# National Aviation Facilities Experimental Center, Atlantic City, N. J.
DESIGN OF AN IMPROVED WEATHER CONTOURING DEVICE Final Report, Nov. 1977 - Sep. 1978
Robert G. Oliver Mar. 1979 71 p
(FAA Proj. 021-241-820)
(AD-A082750; FAA-RD-80-6) Avail: NTIS HC A04/MF A01 CSCL 17/9

A prototype weather contouring device is described which uses the concept of contour symbol generation to produce lines, shaded areas, or other symbols necessary to generate contours of weather intensity. Unlike former techniques, this device generates homogenous lines and is easily programmable for other formats. The device can provide dots or other symbols to the more intense side of a weather contour line clearly aiding the interpretation of the weather display. The device is designed to take advantage of digital signal transmission techniques for the transmission of up to six levels of weather intensity. Any two of these six levels can be simultaneously displayed. The device was designed for those applications where plan position indicator (rho-theta) format is desired or necessary. Tests indicate that the device can generate contours which are exceptionally smooth and stable and are well suited to use in the air traffic control system. M.G.

N80-24946*# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
DETERMINATION OF THE SOLAR ENERGY MICROCLIMATE OF THE UNITED STATES USING SATELLITE DATA Final Report, 12 May 1975 - 11 Nov. 1976
Thomas H. VonderHarr and James S. Ellis Jul. 1978 72 p refs
(Contract NAS5-22372)
(NASA-CR-159987) Avail: NTIS HC A04/MF A01 CSCL 04B

The determination of total solar energy reaching the ground over the United States using measurements from meteorological satellites as the basic data set is examined. The methods of satellite data processing are described. Uncertainty analysis and comparison of results with well calibrated surface pyranometers are used to estimate the probable error in the satellite-based determination of ground insolation. It is 10 to 15 percent for daily information, and about 5 percent for monthly values. However, the natural space and time variability of insolation is much greater than the uncertainty in the method. The most important aspect of the satellite-based technique is the ability to determine the solar energy reaching the ground over small areas where no other measurements are available. Thus, it complements the widely spaced solar radiation measurement network of ground stations. M.G.

N80-24947# Rochester Univ., N. Y. The Graduate School of Management.
GAUSSIAN MARKOV RELATED VARIATES FOR METEOROLOGICAL PLANNING Final Report, 1 Jul. 1978 - 30 Sep. 1979
J. Kelson and H. F. Ross Hanscom AFB, Mass. AFGL 14 Nov. 1979 61 p refs
(Contract F19628-78-C-0158; AF Proj. 6670)
(AD-A081382; AFGL-TR-79-0282) Avail: NTIS HC A04/MF A01 CSCL 04/2

The Gaussian-Markov process or Ornstein-Uhlenbeck (O-U) process successfully models fluctuations in upper level wind velocity, rainfall, temperatures, etc. On-line predictions for longrange operational planning require the distribution of the maximum value of X(t), the stationary O-U process over an interval of specified duration. The required distribution and its basic properties are presented with accompanying tables and graphs. Algorithmic techniques required for on-line predictions are indicated. GRA

N80-24948# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
AIR WEATHER SERVICE (AWS) CLIMATIC BRIEFS: AFRICA Data Summary Report
Dec. 1979 14 p
(AD-A082097; USAFETAC/DS-79/093) Avail: NTIS HC A02/MF A01 CSCL 04/2

Monthly and annual climate data for Africa are presented. Meteorological elements included are: temperature, precipitation, relative humidity, vapor pressure, dew point, pressure altitude, surface wind, mean cloud cover, thunderstorm and fog days, flying weather, and typhoon and hurricane data. R.E.S.

N80-24949# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
AIR WEATHER SERVICE (AWS) CLIMATIC BRIEFS: ASIA Data Summary Report
Dec. 1979 187 p
(AD-A082096; USAFETAC/DS-79/092) Avail: NTIS HC A09/MF A01 CSCL 04/2

Monthly and annual climatic data for Asia are presented. Meteorological elements included are: temperature, precipitation, relative humidity, vapor pressure, dew point, pressure altitude, surface wind, mean cloud cover, thunderstorm and fog days, flying weather, and typhoon and hurricane data. R.E.S.

N80-24950# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
AIR WEATHER SERVICE (AWS) CLIMATIC BRIEFS: USSR AND MONGOLIAN PR Data Summary Report
Dec. 1979 10 p Supersedes AWSP-105-4-Vol-5
(AD-A082095; USAFETAC/DS-79/091; AWSP-105-4-Vol-5)
Avail: NTIS HC A02/MF A01 CSCL 04/2

Monthly and annual climate data for U.S.S.R. and Mongolian PR are presented. Meteorological elements included are: temperature, precipitation, relative humidity, vapor pressure, dew point, pressure altitude, surface wind, mean cloud cover, thunderstorm and fog days, flying weather, and typhoon and hurricane data. R.E.S.

N80-24951# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
AIR WEATHER SERVICE (AWS) CLIMATIC BRIEFS: LATIN AMERICA Data Summary Report
Dec. 1979 18 p Supersedes AWSP-105-4-Vol-3
(AD-A082093; USAFETAC/DS-79/089; AWSP-105-4-Vol-3)
Avail: NTIS HC A02/MF A01 CSCL 04/2

Monthly and annual climate data for Latin America are presented. Meteorological elements included are: temperature, precipitation, relative humidity, vapor pressure, dew point, pressure altitude, surface wind, mean cloud cover, thunderstorm and fog days, flying weather, and typhoon and hurricane data. R.E.S.

N80-24952# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
AIR WEATHER SERVICE (AWS) CLIMATIC BRIEFS: EUROPE Data Summary Report
Dec. 1979 77 p Supersedes AWSP-105-4-Vol-4
(AD-A082094; USAFETAC/DS-79/090; AWSP-105-4-Vol-4)
Avail: NTIS HC A05/MF A01 CSCL 04/2

Monthly and annual climate data for Europe are presented.

Meteorological elements included are: temperature, precipitation, relative humidity, vapor pressure, dew point, pressure altitude, surface wind, mean cloud cover, thunderstorm and fog days, flying weather, and typhoon and hurricane data. R.E.S.

N80-24953# Air Force Geophysics Lab., Hanscom AFB, Mass.
DEVELOPMENT AND EVALUATION OF A TOWER SLANT VISUAL RANGE SYSTEM
Edward B. Geisler Sep. 1979 41 p refs
(AF Proj. 6670)
(AD-A082384; AFGL-TR-79-0209; AFGL-IP-281) Avail: NTIS HC A03/MF A01 CSCL 01/2

Analysis of remote tower forward scatter meter measurements of extinction coefficient collected at the Air Force Geophysics Laboratory Weather Test Facility at Otis AFB, Massachusetts demonstrated the accuracy of a remote tower slant visual range (SVR) system. This report describes the final phase of the development and evaluation of a tower SVR system in which the remote tower approach has been extended to include category 1 operations. Tests give additional evidence that the runway visual range (RVR) measurements are often not representative of pilot visibility during approach and touchdown. An examination of three short range prediction techniques for forecast times of 2, 5, 10, 30 and 60 minutes revealed that the equivalent Markov technique provides accurate and reliable forecasts of below-limit SVR conditions and yields slightly better results than the Markov and REEP techniques. GRA

N80-24954# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
AIR WEATHER SERVICE (AWS) CLIMATIC BRIEFS: ANTARCTICA, AUSTRALIA, AND OCEANIA Data Summary Report
Dec. 1979 47 p
(AD-A082098; USAFETAC/DS-79/094) Avail: NTIS HC A03/MF A01 CSCL 04/2

Monthly and annual climatic data for Antarctica, Australia, and Oceania are summarized. Meteorological elements included are: temperature, precipitation, relative humidity, vapor pressure, dew point, pressure altitude, surface wind, mean cloud cover, thunderstorm and fog days, flying weather, and typhoon and hurricane data. R.E.S.

N80-24955# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
AIR WEATHER SERVICE (AWS) CLIMATIC BRIEFS: NORTH AMERICA Data Summary Report
Dec. 1979 317 p Supersedes ASWP-105-4-Vol-2
(AD-A082092; USAFETAC/DS-79/088; AWSP-105-4-Vol-2) Avail: NTIS HC A14/MF A01 CSCL 04/2

Monthly and annual climate data for North America are summarized. Meteorological elements included are: temperature, precipitation, relative humidity, vapor pressure, dew point, pressure altitude, surface wind, mean cloud cover, thunderstorm and fog days, flying weather, and typhoon and hurricane data. R.E.S.

N80-24956# Weather Wing (3rd), Offutt AFB, Nebr.
COMMA CLOUD DEVELOPMENT RELATED TO MAJOR WINTER STORMS: TWO EXAMPLES
Eugene M. Weber Mar. 1980 15 p refs
(AD-A082125; Rept-3WW/TN-80/002) Avail: NTIS HC A02/MF A01 CSCL 04/2

This technical note discusses the relationship of comma cloud development over the southern Rockies and plain states to the developing storm system. Emphasis is placed on the likelihood that the storm system will soon recurve northeast-ward when the comma cloud becomes well-defined. A brief look at the structure and the development of the comma cloud is included. Two case studies are presented. GRA

N80-24957# Colorado State Univ., Fort Collins. Dept. of Physics.
REMOTE ATMOSPHERIC WIND SPEED MEASUREMENTS BY INDIVIDUAL PARTICLE SCATTERING AND DIGITAL BURST CORRELATION Final Report, 1 Mar. 1978 - 31 Oct. 1979
C. Y. She and Richard F. Kelley Dec. 1979 55 p refs
(Contract N00014-78-C-0289)
(AD-A082347) Avail: NTIS HC A04/MF A01 CSCL 04/2

We have demonstrated that atmospheric wind speeds can indeed be measured with photon bursts scattered from single dust particles. If photon counting, electronics and clipped digital correlation are used for signal analysis, an unambiguous speed measurement can be made with a detected signal as low as ten counts under practical conditions, *i.e.*, in the presence of noise. A microprocessor is used to run the LTV measurements automatically, and to analyze and compare data for both LTV and a conventional cup anemometer. Satisfactory agreement between the LTV and the cup anemometer were obtained. The potential of the LTV with its high speed data acquisition and its short measurement time has been thoroughly demonstrated. In the field test of this automated LTV system, we have conducted speed measurements with both natural aerosols and with seeding of water droplets from a humidifier. To our satisfaction, we obtained better performance without seeding. In short, with the research of this project, we have demonstrated beyond doubt the principle of single-particle scattering for remote speed measurements and also the practical uses of LTV under realistic field conditions. GRA

N80-24958# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
THE 19704A MLRS, MISSILE NO. 067, ROUND NO. B-77, 7 JANUARY 80 Meteorological Data Report
Jan. 1980 15 p
(DA Proj. 1F6-65702-D-127)
(AD-A082974; ERADCOM/ASL-DR-1112) Avail: NTIS HC A02/MF A01 CSCL 04/2

Meteorological data gathered for the launching of 19704A MLRS, Missile Number 067, Round Number B-71 are presented in tabular form. GRA

N80-24959# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
THE 19702B MLRS, MISSILE NUMBERS 028, 353, 027, 351, 352, ROUND NUMBERS B-62, B-63, B-64, B-65, B-66, B-67, 5 JANUARY 1980 Meteorological Data Report
Jan. 1980 21 p
(AD-A082972; ERADCOM/ASL-DR-1109) Avail: NTIS HC A02/MF A01 CSCL 04/2

Meteorological data gathered for the launching of 19702B MLRS, Missile Numbers 028, 005, 353, 027, 351 and 352, Round Numbers B-62, B-63, B-64, B-65, B-66 and B-67 are presented in tabular form. GRA

N80-24960# Institute for Storm Research, Inc., Houston, Tex.
THE DEVELOPMENT OF METHODS OF NUMERICAL DIAGNOSTIC ANALYSIS OF SERIES OF SATELLITE PHOTOGRAPHS Final Report, Nov. 1976 - Feb. 1980
John C. Freeman 28 Feb. 1980 81 p refs
(Grant DAAG29-77-G-0013)
(AD-A082549; ISR-6-13; ARO-13734.4-GS) Avail: NTIS HC A05/MF A01 CSCL 04/2

A research study to develop methods of predicting mesoscale wind and temperature fields is reported on. Two mesoscale weather patterns were studied by an adaptation of optimization principles. Hourly surface pressure and infrared satellite cloud measurements were used as input to the updating scheme. The results shown here illustrate mesoscale properties of the circulation and vertical temperature distribution. GRA

N80-24961# Chicago Univ., Ill. Dept. of Geophysical Sciences.
A QUASI-ONE-DIMENSIONAL CUMULUS CLOUD MODEL AND PARAMETERIZATION OF CUMULUS HEATING AND MIXING EFFECTS Final Report, Nov. 1976 - Sep. 1979
H. L. Kuo and W. H. Raymond Hanscom AFB, Mass. AFGL Nov. 1979 69 p refs
(Contract F19628-77-C-0044; AF Proj. 2310)
(AD-A083024; AFGL-TR-79-0272) Avail: NTIS HC A04/MF A01 CSCL 04/2

The characteristic properties of cumulus convection are investigated using a semi-one-dimensional axisymmetric quasi-Lagrangian steady state model which takes into consideration the influences of the pressure perturbation, density stratification and nearby moist downdraft under two different environmental

situations, namely, 1) a potentially more unstable tropical environment and 2) a less unstable middle latitude environment with prominent stable layers in middle troposphere. It is found that the compressional heating of the dry environment makes the cloud air warmer and reduces the updraft velocity slightly and moist downdraft cools the cloud air and reduces both the updraft and the cloud depth, while the influence of pressure perturbation is also to reduce the updraft but it is effective only for clouds of radii larger than 1000 m. The influence of density stratification is to reduce w sub c slightly at low levels and augment w sub c at high levels and to slightly increase the cloud depth. The calculated precipitation rates appear to be close to the representative values obtained from observations. One most interesting result given by the model is that, under the less unstable middle latitude environment, the precipitation rate jumps from lower than .7 cm/hr for cloud radii smaller than 1000 m to more than 5.4 cm/hr for cloud radii greater than 2000 m, reflecting the inhibiting effect of the mid-tropospheric stable layer on the penetrative power of the smaller clouds.GRA

N80-24962# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
THE 19308B MLRS, MISSILE NO. 1091, ROUND NO. V-96, 8 DECEMBER 1979 Meteorological Data Report
Dec. 1979 17 p
(DA Proj. 1F6-65702-D-127)
(AD-A082967; ERADCOM/ASL-DR-1101) Avail: NTIS HC A02/MF A01 CSCL 04/2
Meteorological data gathered for the launching of the 19308B MLRS, Missile Number 1091, Round Number V-96 are presented in tabular form. GRA

N80-24963# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
THE 19308B MLRS, MISSILE NO. 1057, ROUND NO. 1057 V-97, 8 DECEMBER 1979 Meteorological Data Report
8 Dec. 1979 16 p
(DA Proj. 1F6-65702-D-127)
(AD-A082968; ERADCOM/ASL-DR-1102) Avail: NTIS HC A02/MF A01 CSCL 04/2
Meteorological data gathered for the launching of the 19308B MLRS, Missile Number 1057, Round Number V-97 are presented in tabular form. GRA

N80-24964# California Univ., Livermore. Lawrence Livermore Lab.
NUMERICAL WIND FIELD MODEL VALIDATION FOR A COMPLEX TERRAIN AREA IN THE VICINITY OF LAWRENCE LIVERMORE LABORATORY
W. M. Porch, H. Walker, C. R. Veith, and M. H. Dickerson 20 Sep. 1979 35 p refs
(Contract W-7405-eng-48)
(UCRL-52837) Avail: NTIS HC A03/MF A01
The computer program, MATHEW, a mass consistent wind field model including topography, was tested using statistically selected data stations in the region of Lawrence Livermore Laboratory (LLL). Predicted versus measured winds were compared for data taken across a windy pass in the hills 3 km east of LLL. The topographic scale and the number of selected stations were varied to assess their relative impact on the agreement the winds predicted by the model and those measured at Patterson Pass. The test results for a one hour data set show that the model underestimates the measured winds by 25% and the wind energy by a factor of 2.4, with little dependence on topographic scale and some dependence on which data stations were included in the model; however, high winds were predicted in high wind areas. DOE

N80-24965# Wyoming Univ., Laramie. Dept. of Atmospheric Science.
CATALOG OF AVAILABLE WIND DATA IN IDAHO, MONTANA AND WYOMING
J. D. Marwitz and K. B. Gilkey Feb. 1979 42 p
(Contract EY-76-S-06-2343)
(RLO-2343-79/1) Avail: NTIS HC A03/MF A01
A catalog of available wind data was assembled for the states of Idaho, Montana and Wyoming. Data collected by approximately 100 surface anemometers and 12 to 15 instrumented towers operated for various lengths of time are presented. Most of these data are available from areas of high wind and areas with significant numbers of eolian features. Only a minimum amount of these data are analyzed and then only for single station climatology. DOE

N80-24966# Battelle Pacific Northwest Labs., Richland, Wash.
WIND RESOURCE ASSESSMENT STATUS
L. L. Wendell 1979 13 p refs Presented at the EPRI Workshop on Econ. and Operational Requirements and Status of Large-Scale Wind Systems, Monterey, Calif., 28-30 Mar. 1979
(Contract EY-76-C-06-1830)
(PNL-SA-6918-Rev-1) Avail: NTIS HC A02/MF A01
Prototype techniques for the analysis of wind energy potential and distribution over a large area were developed. These techniques involve the utilization of a large data set, the application of meteorological and topographic factors in the analysis, and the use of indirect methods of wind power estimation in areas where no wind measurements exist. The techniques were tested in five Pacific Northwest states. DOE

N80-24967# Hawaii Univ., Honolulu. Water Resources Research Center.
PROJECT AHUPUAA: SOLAR METEOROLOGICAL FIELD MEASUREMENTS ON THE ISLAND OF HAWAII, SUMMER 1978. 2: EASTERN FLANK OF MAUNA LOA
P. C. Ekern and Alfred J. Garrett Aug. 1979 63 p refs
(Grant EG-77-G-03-1617)
(UHMET-79-04) Avail: NTIS HC A04/MF A01
During 1-11 June 1978, solar radiation and other meteorological data were gathered at eight stations in a nearly linear transect on the windward eastern slopes of Hawaii, extending from the coast of Hilo, Hawaii to Mauna Loa Observatory (MLO), 60 km inland and 3400 m higher. In general, synoptic conditions were representative of normal early summer trade wind weather with a frontal remnant to the north, and a small westward-moving depression to the south. Solar radiation distributions followed climatological rainfall patterns; the driest areas were sunniest. At the wettest sites, underneath the orographic cloud, measured global solar radiation was only 50 percent of clear-sky potential, and the diffuse component probably accounted for more than 50 percent of the global. Consequently, effective concentration of solar radiation for use as an alternate energy resource will be difficult in such areas. The orographic cloud developed during the day in anabatic/trade winds of 2 to 4 m/s, which sharply reduced afternoon solar radiation at sites, including MLO on 7 out of 11 days. Moist upslope flow penetrated the trade wind inversion by 0.5 to 1.5 km on weak inversion days. When the inversion was strong, MLO was dry and clear all day. Cloudiness, and hence insolation, varied greatly from day-to-day due to passage of trade wind cloud masses and jet stream cirrus. Even so, the island effect was always significant. This data and analyses can be used by mesoscale numerical modelers, particulary those attempting to simulate orographic cloud development. DOE

N80-24968# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.
STATISTICAL MODELS FOR WIND CHARACTERISTICS AT POTENTIAL WIND ENERGY CONVERSION SITES Final Report, 15 Sep. 1977 - 14 Oct. 1978
R. B. Corotis Jan. 1979 86 p refs
(Contract EY-76-S-06-2342)
(DOE/ET/20283-1; RLO-2342-79/1) Avail: NTIS HC A05/MF A01
Simple models and guidelines are developed for wind energy site surveys. Probabilistic procedures are employed to assess survey duration, climatological adjustment, and run duration statistics. A climatological adjustment procedure is derived for the enhancement of candidate site data from a reference site with long term data, and the computation of confidence intervals is shown for existing data and for projected survey durations. The value of the enhancement procedure is diminished because of the sensitivity of the procedures to long term cross correlations. A simplified run duration model is developed for initial persistence assessment. The model is simply calibrated for each run level from the seasonal mean wind speed at a site. DOE

N80-24969# Danish Meteorological Inst., Copenhagen.
DANISH EXPERIENCE AND PLANS FOR ESTABLISHMENT OF ARCTIC WEATHER OBSERVING STATIONS
Joergen Taagholt and Niels Woetmann Boulder, Colo. Intern. Assoc. of Meteorol. and Atmospheric Phys. Feb. 1979 11 p refs Presented at Joint IAGA/IAMAP Assem., Seattle, 22 Aug. - 3 Sep. 1977
Avail: NTIS HC A02/MF A01

The design, location, and operation of Unmanned Geophysical Observatories (UGO-stations) as well as of Automatic Weather Stations (AWS) are reported on. Experience gained to date concerning the need for this kind of meteorological data, maintainability of the installations, and the benefits of various equipment innovations is cited. The data collection system is analyzed and several configurations are proposed based on cost effectiveness. Author (ESA)

N80-24970# Danish Meteorological Inst., Copenhagen.
ON THE GENERAL AND SPECIFIC NATIONAL AND INTERNATIONAL NEED FOR METEOROLOGICAL DATA FROM THE GREENLAND AREA
Niels Woetmann and Joergen Taagholt Boulder, Colo. Intern. Assoc. of Meteorol. and Atmospheric Phys. Feb. 1979 9 p refs Presented at Joint IAGA/IAMAP Assem., Seattle, 22 Aug. - 3 Sep. 1977
Avail: NTIS HC A02/MF A01

Arguments based on the needs of aviation, industry, and industrial fishing for better meteorological data are presented in support of the establishment of unmanned geophysical observatories. Climatological factors, such as katabatic wind, surface wind, pressure gradient, and temperature, important in the analysis and forecasting of weather conditions are discussed. Results obtained from those stations already in place are cited as evidence of the reliability of these installations. Author (ESA)

N80-24971# Illinois State Water Survey, Urbana.
SPATIAL AND TEMPORAL CORRELATION OF PRECIPITATION IN ILLINOIS
Floyd A. Huff 1979 19 p refs Sponsored in part by OWRT (PB80-137706; ISWS/CIR-141/79; W80-02882) Avail: NTIS HC A02/MF A01 CSCL 04B

Analyses were made of the correlation patterns of annual, seasonal, monthly, storm, and partial storm precipitation in Illinois, with major emphasis on the warm season months of May - September when convective rainfall dominates and spatial variability maximizes. Data were from the climatic network of the National Weather Service in the annual analyses, and that from dense raingage networks of the State Water Survey in the seasonal, monthly, and storm analyses. Results provide knowledge and basic information concerning the spatial and temporal distribution characteristics of precipitation. This is needed in various endeavors, such as hydrologic studies, weather modification experiments, and agricultural research. GRA

N80-24972# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
OBSERVATIONAL ANALYSIS OF TROPICAL CYCLONE FORMATION
John L. McBride and William M. Gray Apr. 1979 242 p refs (Contract N00228-76-C-2129; Grants NSF ATM-78-18962; NOAA-NA79-RAD-00002)
(PB80-133614; AS-PAPER-308) Avail: NTIS HC A11/MF A01 CSCL 04B

This study investigates the genesis of tropical cyclones through a combination of the compositing approach and the case study approach. Twelve composite data sets are analyzed from the tropical Northwest Pacific and tropical Northwest Atlantic Oceans. Each data set is a composite average of approximately 80 individual disturbances. Four different types of nondeveloping oceanic tropical disturbances are composited. They are compared with pre-hurricane and pre-typhoon disturbances in each ocean composited at four different stages of intensification. In total, 912 different tropical weather systems go into the composites and approximately 40,000 rawinsonde observations are used. Vertically integrated budgets of heat, momentum and kinetic energy are performed on the composite data sets and physical hypotheses are made on the mechanisms of tropical cyclone genesis and development. GRA

N80-24973# Systems Applications, Inc., San Rafael, Calif.
MODELING WIND DISTRIBUTIONS OVER COMPLEX TERRAIN
Mark A. Yocke and Mei-Kao Liu Oct. 1979 122 p refs (Contract EPA-68-02-2446)
(PB80-140783; EPA-600/4-79-066) Avail: NTIS HC A06/MF A01 CSCL 04B

Accurate determination of wind fields is a prerequisite for successful air quality modeling. Thus, there is an increasing demand for objective techniques for analyzing and predicting wind distribution, particularly over rugged terrain, where the wind patterns are not only more complex, but also more difficult to characterize experimentally. This report describes the development of a three dimensional wind model for rugged terrain based on mass continuity. The model is composed of several horizontal layers of variable thicknesses. For each layer, a Poisson equation is written with the wind convergence as the forcing function. Many types of wind perturbations over rugged terrain are considered in this model including diversion of the flow due to topographical effects, modification of wind profiles due to boundary layer frictional effects, convergence of the flow due to urban heat island effects, and mountain and valley winds due to thermal effects. Wind data collected during a comprehensive field measurement program at Phoenix, Arizona, were used to test the model. GRA

N80-24974# National Oceanic and Atmospheric Administration, Rockville, Md. Atmospheric Programs Office.
WEATHER MODIFICATION REPORTING PROGRAM, 1973-1978. PART 1: SUMMARY OF WEATHER MODIFICATION ACTIVITIES FOR CALENDAR YEARS 1976, 1977 AND 1978. PART 2: COMPARISON OF DATA REPORTED SINCE 1973
Mason T. Charak Jun. 1979 78 p refs
(PB80-145055; NOAA-79110702) Avail: NTIS HC A05/MF A01 CSCL 04B

Part 1 is a summary of reported weather modification activities for calendar years 1976, 1977, and 1978. Information presented on the reported weather modification projects includes purposes, locations, sponsors, operators, equipment, techniques, target areas, seeding agents, seeding duration, operational considerations, and environmental factors. In Part 2, some adjusted data from published summaries of activities for 1973-1975 are compared with the data for Part 1. GRA

N80-24722*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR WEATHER/CLIMATE PREDICTIONS
K. Schatten (Boston Univ.), Richard A. Goldberg, J. M. Mitchell (NOAA, Silver Spring, Md.), R. Olson (Aspen Inst. for Humanistic Studies, Boulder, Colo.), J. Schaefer (Bonn Univ.), S. Silverman (AFGL), J. Wilcox (Stanford Univ.), and G. Williams (Southampton Univ.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 655-668 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04B

N80-24723*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COUPLING PROCESSES RELATED TO THE SUN-WEATHER PROBLEM
Richard A. Goldberg and John R. Herman (Radio Sci. Co., Melbourne, Fla.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 669-688 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04B

N80-24724*# Cornell Univ., Ithaca, N. Y. Atmospheric Sciences Div.
THE IMPACT OF SUN-WEATHER RESEARCH ON FORECASTING
Miguel F. Larsen *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 689-702 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04B

N80-24725*# Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.

PLANETARY WAVES AND SUN-WEATHER EFFECTS
H. Volland and J. Schaefer (Bonn Univ.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 703-721 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 04B

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography, and marine resources.

N80-24975*# Business and Technological Systems, Inc., Seabrook, Md.
GLOBAL EARTH RESPONSE TO LOADING BY OCEAN TIDE MODELS Final Report
Ronald H. Estes and James M. Strayer Jun. 1979 64 p refs (Contract NASS-25010)
(NASA-CR-159984) Avail: NTIS HC A04/MF A01 CSCL 08C

Mathematical and programming techniques to numerically calculate Earth response to global semidiurnal and diurnal ocean tide models were developed. Global vertical crustal deformations were evaluated for M sub 2, S sub 2, N sub 2, K sub 2, K sub 1, O sub 1, and P sub 1 ocean tide loading, while horizontal deformations were evaluated for the M sub 2 tidal load. Tidal gravity calculations were performed for M sub 2 tidal loads, and strain tensor elements were evaluated for M sub 2 loads. The M sub 2 solution used for the ocean tide included the effects of self-gravitation and crustal loading. R.E.S.

N80-24976# Naval Postgraduate School, Monterey, Calif.
PREPARATION OF OCEAN MODEL FORCING PARAMETERS FROM FNWC ATMOSPHERIC ANALYSIS AND MODEL PREDICTIONS Technical Report, Dec. 1978 - Sep. 1979
Patrick C. Gallacher Dec. 1979 29 p refs
(AD-A081611; NPS63-79-005) Avail: NTIS HC A03/MF A01 CSCL 08/3

A software system is described which produces atmospheric fields on the time scale necessary to force the Garwood (1977) mixed layer model. The fields required are the surface wind speed, solar radiation and total heat flux. These fields are obtained from the NORPAX data center and from FNWC. The winds are available at 6 hour intervals and the heat fluxes at 12 hour intervals. The software system edits, reformats and interpolates the fields to 1 hour intervals. The system also provides the capability to extract specific grid points for any time interval desired. GRA

N80-24977*# National Aeronautics and Space Administration, Washington, D. C.
CATALOG OF FEDERAL OCEAN POLLUTION RESEARCH, DEVELOPMENT AND MONITORING PROGRAMS, FISCAL YEARS 1978 - 1980
Aug. 1979 271 p Sponsored in cooperation with the Interagency Commission on Ocean Pollution Research, Development, and Monitoring Prepared in cooperation with NOAA, Washington, D.C.
(NASA-TM-81071; PB80-140171; NOAA-80011801; Working-Paper-1) Avail: NTIS HC A12/MF A01 CSCL 08J

The National Ocean Pollution Research and Development and Monitoring Planning Act of 1978 was signed as Public Law 95 273, in May 1978, to establish a comprehensive 5 year plan to provide planning for, coordination of, and dissemination of, information with respect to such programs within the Federal Government. A detailed inventory of Federal ocean pollution research, development, and monitoring programs is presented as the basis upon which all descriptions and analyses of Federal activities in this area are made. The overall program is anlayzed from the perspectives of pollutants under study, specific geographic concerns, sources, or causes of pollution and control and mitigation. GRA

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N80-24978*# National Aeronautics and Space Administration, Washington, D. C.
GROWTH AND FORMATION OF THE FORELEG SKELETON IN INBRED MICE AND RATS UNDER CONDITIONS OF HYPO-, NORMO- AND HYPERDYNAMIA
B. I. Kogan and Yu. S. Antipov Jan. 1980 10 p refs Transl. into ENGLISH from Vestn. Zool. (USSR), no. 4, 1976 p 67-71 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by USSR Acad. of Pedagogical Sci.
(Contract NASw-3198)
(NASA-TM-75977) Avail: NTIS HC A02/MF A01 CSCL 06C

Inbred 1 month old males of C57B 1/6, CBA, CC57Br/Mw interlinear hybrid mice of the first generation and rats of the August and Wistar lines were subjected to conditions of hypo-, normo- and hyperdynamia for 2 months. The statistically reliable dependence is shown between mechanical underloadings and overloadings and macro microscopic changes in the hind limb skeleton of animals. Genetic determination of growth and formation of the forelimb skeleton is established. Hereditary susceptibility and the phenomenon of heterosis are preserved under all motor conditions. Author

N80-24979*# National Aeronautics and Space Administration, Washington, D. C.
PLANTS AND WEIGHTLESSNESS
V. Karminskiy and V. Tarkhanovskiy Jan. 1980 4 p Transl. into ENGLISH from Tekhn. i Nauka (Moscow), no. 11, 1978 p 10 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-3198)
(NASA-TM-76025) Avail: NTIS HC A02/MF A01 CSCL 06C

The growth of two plants, wall cress and short-day red goosefoot, was traced for their entire lifetime in weightlessness. In the beginning both plants grew normally: the seeds sprouted in the normal periods, and the shoots did not differ in any way from the control plants. It is true that certain roots lost their normal orientation and did not go deeper into the nutrient medium, but rather crept over its surface. But then both the wall cress and the goosefoot slowed down their normal rate of growth, which became noticeable from the rate of formation of new leaves in the wall cress and stem development in the goosefoot. Although no disorders were successfully found in the morphology of the two plants, almost half of the experimental cress and goosefoot plants ceased growth completely, yellowed and died. The other part continued to develop normally and by the end of vegetation, differed from the control plants only in a lower height. Not all were fertile since certain experimental plants, after losing spatial orientation, became twisted and produced sterile flowers. R.E.S.

N80-24980*# National Aeronautics and Space Administration, Washington, D. C.
CHANGE IN RADIO SENSITIVITY OF MICE UNDER EFFECT OF ROTATION
N. I. Arlashchenko, V. M. Seraya, and G. P. Rodina Jan. 1980 12 p refs Transl. into ENGLISH from Radiobiol. (USSR), no. 2, 1979 p 251-256 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Inst. of Med. and Biol. Probl. of the USSR Min. of Public Health
(Contract NASw-3198)
(NASA-TM-76026) Avail: NTIS HC A02/MF A01 CSCL 06C

Radiosensitivity of animals placed in slowly rotating chambers was investigated and was found to vary under the influence of the functional load on the vestibular analyzer. An increased radioresistance was registered in populations of the most radiosensitive mice. In populations of more radioresistant animals the gravitational load decreases the radioresistance. R.E.S.

N80-24981*# National Aeronautics and Space Administration, Washington, D. C.

CONTENT OF TOTAL IRON, COPPER AND MANGANESE IN LIVER OF ANIMALS DURING HYPOKINESIA, MUSCLE ACTIVITY AND PROCESS OF RECOVERY

G. M. Putapovich, G. V. Taneyeva, and A. B. Uteshev 30 May 1980 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk Kaz. SSR, Ser. Biol. (USSR), no. 4, Jul. - Aug. 1978 p 63-66 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by the Kazakh SSR Min. of Public Health, Alma-Ata

(Contract NASw-3198)

(NASA-TM-76130) Avail: NTIS HC A02/MF A01 CSCL 06C

It is shown that the content of total iron, copper and manganese in the liver of animals is altered depending on the intensity and duration of their swimming. Hypodynamia for 7 days does not alter the concentration of iron, but sufficiently increases the content of copper and manganese. The barometric factor effectively influences the maintenance of constancy in the content of microelements accumulated in the liver after intensive muscle activity. Author

N80-24982*# Hampton Inst., Va. Dept. of Physics.

A RADIATIVE TRANSFER MODEL FOR REMOTE SENSING OF LASER INDUCED FLUORESCENCE OF PHYTOPLANKTON IN NON-HOMOGENEOUS TURBID WATER Annual Report

D. D. Venable May 1980 57 p refs

(NASA-CR-163155) Avail: NTIS HC A04/MF A01 CSCL 08C

A radiative transfer computer model was developed to characterize the total flux of chlorophyll a fluoresced or backscattered photons when laser radiation is incident on turbid water that contains a non-homogeneous suspension of inorganic sediments and phytoplankton. The radiative transfer model is based on the Monte Carlo technique and assumes that: (1) the aquatic medium can be represented by a stratified concentration profile; and (2) that appropriate optical parameters can be defined for each layer. The model was designed to minimize the required computer resources and run time. Results are presented for an anacystis marinus culture. R.E.S.

N80-24983*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY RESULTS OF FAST NEUTRON TREATMENTS IN CARCINOMA OF THE PANCREAS

Reinhard Gahbauer, Kyee Y. Koh, Antonio Rodriguez-Antunez, Gwynn L. Jelden, Robert F. Turco, John Horton, Ronald Bukowski, Ronald Reimer, James Blue, William Roberts et al 1980 4 p Presented at the National Pancreatic Proj., New Orleans, 18 Apr. 1980 Prepared in cooperation with Cleveland Clinic Foundation, Ohio

(NASA-TM-81516; E-460) Avail: NTIS HC A02/MF A01 CSCL 06E

A group of 30 patients with adenocarcinoma of the pancreas including some patients with very advanced disease, were treated with the so-called mixed beam modality employing photon treatments three times per week and neutron treatments twice a week. Two hundred Rads or equivalent Rads (RBE 3.3) were given in daily fractions aiming at a total dose of 6000 Rads in 6 to 8 weeks. The treatments were well tolerated and significant palliation was achieved in 26 to 30 cases. Twelve months survival was 33 percent with a median survival of 7 months or 210 days. Treatment techniques and localization procedures are discussed. R.E.S.

N80-24984# Rancho Los Amigos Hospital, Inc., Downey, Calif.

STUDIES ON OXYGEN TOXICITY IN THE LUNGS Final Technical Report, 1 May 1970 - 29 Feb. 1980

Jack D. Hackney 29 Feb. 1980 51 p refs

(Contract N00014-78-C-0290)

(AD-A082546) Avail: NTIS HC A04/MF A01 CSCL 06/20

Work on two animal species has shown that during the first day of exposure to high concentrations of oxygen (O2), the normal rate of cell division in the lung is decreased. In animals that survive the initial exposure to O2 or in those exposed to a lower concentration, cell division resumes after about five days. In animals exposed to O2, it has been noted that they eat less and lose weight. Air-breathing mice deprived of food had weight loss and depression in DNA synthesis similar to that observed in mice exposed to 95 percent O2. These results indicate that indirect factors are associated with the depression of DNA synthesis observed in mice exposed to high O2. Lack of food or 40 percent O2 did not inhibit type 2 division associated with repair of ozone damaged alveolar epithelium. Oxygen concentrations of 61 percent or higher did inhibit reparative cell division in ozone damaged alveoli of mice. GRA

N80-24985# Rochester Univ., N. Y. School of Medicine and Dentistry.

BIOLOGICAL EFFECTS OF IONIZING RADIATION AT THE MOLECULAR, CELLULAR AND ORGANISMAL LEVELS Annual Progress Report, 15 Oct. 1978 - 14 Oct. 1979

C. S. Lange 1979 13 p refs

(Contract EY-76-S-02-3501)

(CDO-3501-13) Avail: NTIS HC A02/MF A01

The Zimm theory of rotor speed dependent DNA sedimentation has been tested quantitatively and found to be correct as predicted by the equation of Zimm and Schumaker. The quantitative validity of the theory means that the size of a DNA sedimenting under speed-dependent conditions is not undefinable but rather can be uniquely obtained by the application of that theory to the data. The viscoelastic recoil or more accurately, the zero shear rate reduced recoil was shown to be a quantitative direct function of the number of intact DNA molecules present in solution. This demonstration made possible the measurement of a direct survival curve for intact DNA molecules after exposure to ionizing radiation. A D37 of 49.5 krads was obtained for the DNA of T4c coliphage irradiated as a solution of phage particles. It is noteworthy that this survival curve measures the number of intact DNA molecules, not the average number of breaks/molecule. DOE

N80-24986# National Academy of Sciences - National Research Council, Washington, D. C. Board on Science and Technology for International Development.

MICROBIAL PROCESSES: PROMISING TECHNOLOGIES FOR DEVELOPING COUNTRIES Final Report

Feb. 1980 215 p refs

(Contract AID/csd-2584)

(PB80-144686; CIR/BOSTID-80/28) Avail: NTIS HC A10/MF A01 CSCL 06K

Ten subpanels selected a number of microbial processes that met either of the following criteria: the process can be beneficially employed in developing countries, or the process has sufficient potential for developing countries to merit research and development for future use. Microbes can be marshaled to aid in solving many important global problems including food storages, resource recovery and reuse, energy shortages, and pollution. Microbiology is particularly suited to make important contributions to human needs in developing countries, yet it has received comparatively little attention. The range of possible applications covers uses by individuals and industries in rural settings, villages and cities. The ten subject areas covered include raw materials for microbial processes, food and animal feed, soil microbes in plant health and nutrition, nitrogen fixation, microbial insect control agents, fuel and energy, waste treatment and utilization, cellulose conversion, antibiotic and vaccines, and pure cultures for microbial processes. GRA

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N80-24987* National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY. A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 206, MAY 1980

May 1980 61 p

(NASA-SP-7011(206)) Avail: NTIS HC $7.00 CSCL 06E

This bibliography lists 169 reports, articles, and other documents introduced into the NASA scientific and technical information system in April 1980. Author

N80-24988*# National Aeronautics and Space Administration, Washington, D. C.
FREE AMINO ACIDS OF THE BLOOD AND SOME ORGANS IN HYPOKINESIA
B. M. Kurtser, L. N. Kobylyanskiy, S. A. Lysenko, and L. I. Tkachenko Jan. 1980 6 p refs Transl. into ENGLISH from Zdravookhraneniye (USSR), v. 18, no. 4, 1975 p 26-27 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by the Kishinev Med. Inst., USSR
(Contract NASw-3198)
(NASA-TM-75945) Avail: NTIS HC A02/MF A01 CSCL 06P

The metabolic fund of amino acids of the blood and tissues of rats under hypokinesia was investigated. The content of free amino acids was determined for the liver, kidney, brain, and the skeletal and cardiac muscles after established periods of hypokinesia. It was found that the total content of free amino acids in the experimental animals was, on the average 19 percent lower than in the controls. The results of the quantity of individual compounds indicate that the level of some were reduced while others were increased. It was also found that there was an unequal content of individual amino acids in the different tissues. R.E.S.

N80-24989*# National Aeronautics and Space Administration, Washington, D. C.
HYPODYNAMIC AND HYPOKINETIC CONDITION OF SKELETAL MUSCLES
G. S. Katinas, V. S. Oganov, and A. N. Potapov Feb. 1980 7 p refs Transl. into ENGLISH from Fiz. Zh. SSSR (USSR), v. 60, no. 10, 1974 p 1606-1608 Original language document was announced as A75-14852 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Min. Inst. for Medicobiol. Probl., Moscow, USSR
(Contract NASw-3199)
(NASA-TM-76009) Avail: NTIS HC A02/MF A01 CSCL 06P

Data are presented in regard to the effect of unilateral brachial amputation on the physiological characteristics of two functionally different muscles, the brachial muscle (flexor of the brachium) and the medial head of the brachial triceps muscle (extensor of the brachium), which in rats represents a separate muscle. Hypokinesia and hypodynamia were studied. Author

N80-24990*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF PRODUCTION MICROCLIMATE ON FEMALE THERMAL STATE WITH INCREASED TEMPERATURE AND AIR HUMIDITY
O. G. Machabishvili Mar. 1980 6 p refs Transl. into ENGLISH from Vrachebnoye Delo (Kiev), no. 6, Jun. 1979 p 96-98 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by the Georgian SSR Min. of Public Health, USSR
(Contract NASw-3198)
(NASA-TM-76082) Avail: NTIS HC A02/MF A01 CSCL 06S

The thermal state of women during the effect of high air temperature and relative humidity with a varying degree of physical loads was studied. Parameters for air temperature, relative humidity, and air movement were established. It was established that in women the thermo-regulatory stress occurs at lower air temperatures and with lower physical loads than in men. The accumulation of heat in women was revealed with lower air temperature than in men. It is concluded that to preserve the normal physiological state of the female organism it is necessary to create more favorable microclimate conditions and decrease the physical loads. R.E.S.

N80-24991*# National Aeronautics and Space Administration, Washington, D. C.
CARDIOLEADER USE IN ACYCLIC TYPES OF SPORTS
V. I. Bondin Mar. 1980 11 p refs Transl. into ENGLISH from Teor. Prakt. Fiz. Kultury (USSR), no. 6, June 1969 p 34-37 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Bostov State Pedagogical Inst., USSR
(Contract NASw-3199)
(NASA-TM-76085) Avail: NTIS HC A02/MF A01 CSCL 06A

The use of the cardioleader method in regulating training loads and tests for athletes in acyclic sports was investigated. It was found that the use of this method increases the effectiveness of the training process. R.E.S.

N80-24992*# Stanford Univ., Calif. School of Medicine.
NEURON ANALYSIS OF VISUAL PERCEPTION Final Report
Kao Liang Chow May 1980 13 p
(Grant NGR-05-020-435)
(NASA-CR-163137) Avail: NTIS HC A02/MF A01 CSCL 06P

The receptive fields of single cells in the visual system of cat and squirrel monkey were studied investigating the vestibular input affecting the cells, and the cell's responses during visual discrimination learning process. The receptive field characteristics of the rabbit visual system, its normal development, its abnormal development following visual deprivation, and on the structural and functional re-organization of the visual system following neo-natal and prenatal surgery were also studied. The results of each individual part of each investigation are detailed. R.E.S.

N80-24993*# Clarkson Coll. of Technology, Potsdam, N.Y.
LIGHT FLASH PHENOMENA INDUCED BY HzE PARTICLES Final Report
P. J. McNulty and V. P. Pease 31 Mar. 1980 51 p refs
(Grant NsG-9059; Contract F30602-78-C-0102)
(NASA-CR-163011) Avail: NTIS HC A04/MF A01 CSCL 06P

Astronauts and Apollo and Skylab missions have reported observing a variety of visual phenomena when their eyes are closed and adapted to darkness. These phenomena have been collectively labelled as light flashes. Visual phenomena which are similar in appearance to those observed in space have been demonstrated at the number of accelerator facilities by expressing the eyes of human subjects to beams of various types of radiation. In some laboratory experiments Cerenkov radiation was found to be the basis for the flashes observed while in other experiments Cerenkov radiation could apparently be ruled out. Experiments that differentiate between Cerenkov radiation and other possible mechanisms for inducing visual phenomena was then compared. The phenomena obtained in the presence and absence of Cerenkov radiation were designed and conducted. A new mechanism proposed to explain the visual phenomena observed by Skylab astronauts as they passed through the South Atlantic Anomaly, namely nuclear interactions in and near the sensitive layer of the retina, is covered. Also some studies to search for similar transient effects of space radiation on sensors and microcomputer memories are described. R.E.S.

N80-24994# Clemson Univ., S.C. Coll. of Engineering.
AN EVALUATION OF HUMAN THERMAL MODELS FOR THE STUDY OF IMMERSION HYPOTHERMIA PROTECTION EQUIPMENT Final Report, 17 Jan. 1978 - 21 Aug. 1979
R. Michael Harnett, IV Baker E. R., and Jeffrey L. Ringuest 12 Oct. 1979 107 p refs
(Contract DOT-CG-72074-A)
(AD-A081100; USCG-D-80-79) Avail: NTIS HC A06/MF A01 CSCL 06/19

This report presents an evaluation of mathematical models of a man in a cold environment. The models are evaluated for their ability to predict the effectiveness of anti-exposure equipment use during cold water immersion. The evaluation is done by comparison of model results to those observed during in vivo cold immersions with a wide range of anti-exposure equipment. The models evaluated are those, available in the literature, which employ a metabolic rate control submodel. Model results obtained with modified and experimental submodels are discussed. GRA

N80-24995# Army Research Inst. of Environmental Medicine, Natick, Mass.
PHYSIOLOGICAL RESPONSES OF MEN AND WOMEN TO HUMID AND DRY HEAT
Yair Shapiro, Kent B. Pandolf, Barbara A. Avellini, Nancy A. Pimental, and Ralph F. Goldman Nov. 1979 30 p refs
(DA Proj. 3E1-62777-A-845)
(AD-A079573) Avail: NTIS HC A03/MF A01 CSCL 06/19

The major objective of this study was to determine whether

sex-related differences in thermoregulation exist; and if so, whether there was any method to define these differences. A major methodological problem of the study was the inability to find groups of males and females matched in all their physical characteristics, namely: body weight, skin surface area, percentage of body fat and cardiorespiratory physical fitness. This problem was partially solved by dividing each sex into two subgroups and matching the subgroups as 'small' males vs. 'big' females, or more fit females vs. less fit males. The sex-related differences concluded from this investigation are summarized in Table 4. In comfortable climatic conditions (20 C, 40% rh) men and women reacted in a physiologically similar fashion. Under wet conditions, whether mild or hot, females tolerated the heat better than males. They displayed lower deep body and skin temperatures, and therefore lower heat storage, while demonstrating lower sweat rates and subsequently less dehydration than males. In contrast, under hot-dry conditions, males seemed to be at a physiological advantage. Compared to females, they showed lower deep body and skin temperatures, lower HR, lower heat storage, and similar sweat rates. GRA

N80-24996# Undersea Medical Society, Bethesda, Md.
MONITORING VITAL SIGNS IN THE DIVER Special Report
Claes E. G. Lundgren 1979 121 p refs
(Contract N00014-74-C-0319)
(AD-A071920; WS-78-2) Avail: NTIS HC A06/MF A01 CSCL 06/5

Various aspects of monitoring vital signs in the diver are discussed. Special consideration is given to monitoring heat loss, temperature, and eye movement. Performance measures and voice monitoring were considered extremely important. It is concluded that monitoring is highly desirable and is within the capability of present equipment. It was recognized however that monitoring in-sea divers is difficult and complicated because of unwillingness on the part of divers and tenders to cooperate. R.E.S.

N80-24997# Saint Louis Univ., Mo. Dept. of Physiology.
HEMATOLOGICAL ASPECTS OF HEAT STRESS IN TRAINED AND UNTRAINED MEN WITH SPECIAL EMPHASIS ON ERYTHROCYTE VOLUME, ACID-BASE BALANCE AND FLUID-ELECTROLYTE SHIFTS Final Report, 1 May 1976 - 31 Aug. 1978
W. vanBeaumont, S. Underkofler, and S. vanBeaumont 15 Jun. 1979 46 p refs
(Contract N00014-76-C-0795)
(AD-A071757) Avail: NTIS HC A03/MF A01 CSCL 06/19

The results of the present study indicate that with 30 min of continuous sub-maximal exercise in a cool environment (24 C) or a warm environment (40 C), the plasma volume rates of decrease and restoration are virtually identical. At all levels of sub-maximal performance, restoration of plasma volume was 80-90% complete in 30 min post-excercise and 100% complete in 60 min. The regression equation for calculating proportional changes in plasma volume, using changes in hematocrit and hemoglobin indicate that the changes in mean erythrocyte volume (MCV) were small. However, based on statistical analyses it is apparent that significant changes in the MCV do occur during sub-maximal exercise. Physical training decreased plasma complexity and increased the size of the human erythrocyte. Proportionally, the shift of plasma water during maximal exercise was similar before and after training. Acclimatization to heat induced increments in MCV which, however, were not statistically significant. In most acclimatized subjects there was a tendency for quicker restoration of plasma volume than in nonheat acclimatized subjects after exercise in the heat. These changes are discussed with reference to concomittant changes in plasma complexity and plasma protein. R.E.S.

N80-24998# Army Research Inst. of Environmental Medicine, Natick, Mass.
RESPIRATORY ADAPTATIONS IN ACID-BASE DISTURBANCES: ROLE OF CEREBRAL FLUIDS
V. Fencl and R. A. Gabel 19 Jun. 1979 14 p refs
(DA Proj. 3A1-61101-A-91C)
(AD-A073202) Avail: NTIS HC A02/MF A01 CSCL 06/16

The respiratory and metabolic components of acid-base homeostasis are defined. A quantitative empirical description of the (incomplete) mutal compensations in steady acid-base disturbances primarily occuring in either of the two components is presented, based upon data compiled from the literature. Respiratory adaptations in steady acid-base disturbances of metabolic origin (hyperventilation with hypocapnia in primary metabolic acidosis, and hypoventilation with hypercapnia in metabolic alkalosis) are analyzed as a function of the acidity of the cerebral fluids (cerebrospinal and cerebral interstitial fluid). R.E.S.

N80-24999# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
TREND PREDICTION AS A BASIS FOR OPTIMAL THERAPY: A SURVEY REPORT
J. E. Beneken, J. A. Blom, F. F. Jorritsma, A. Nandorff (Leiden Univ., Netherlands), and J. Spierdijk (Leiden Univ., Netherlands) Aug. 1978 71 p refs
(TH-78-E-86; ISBN-90-6144-086-6) Avail: NTIS HC A04/MF A01

A state-of-the-art survey in clinical trend prediction as a basis for optimizing therapy, with emphasis on research being done in the countries of the European Community, was conducted. Special areas of interest are quantitative prognosis (prognostic indices), the detection and use of trends in the patient's state, the use of models in prediction and their possible use for deciding which therapy is optimal for a specific patient. An extensive list of centers working in these fields as well as an extensive reference list is included. Author (ESA)

N80-25000# Istituto Superiore di Sanita, Rome (Italy). Lab. delle Radiazioni.
BIOLOGICAL EFFECTS OF ULTRAVIOLET RADIATION [EFFETTI BIOLOGICI DELLA RADIAZIONE ULTRAVIOLETTA]
M. Cremonese and M. Matzeu 9 Jul. 1979 54 p refs In ITALIAN
(ISS-R-79/5; ISSN-0390-6477) Avail: NTIS HC A04/MF A01

A review is presented of the most important effects produced by ultraviolet radiation with particular regard to the possible pathologic effects on man. A molecular interpretation of DNA alterations by the action of UV radiation is discussed, presenting experimental evidence of the effect upon cellular cultures and damages inflicted to human skin and eyes. The carcenogenic effects are related to this interpretation. Some statuory problems are discussed in connection with health protection against ultraviolet radiation. Author (ESA)

N80-25001# National Asthma Center, Denver, Colo. Dept. of Physiology.
LOW-LEVEL CARBON MONOXIDE EXPOSURE AND WORK CAPACITY AT 1600 METERS
Philip C. Weiser, Gerd J. A. Cropp, Callis G. Morrill, Thomas L. Kurt, and David W. Dickey Sep. 1979 35 p refs
(Contract EPA-68-02-2244)
(PB80-129083; EPA-600/1-79-037) Avail: NTIS HC A03/MF A01 CSCL 06T

At sea level low-level carbon monoxide (CO) exposure impairs exercise performance. To determine if altitude residence at 1600 m augments this CO effect, two studies of graded treadmill work capacity were done. In both studies, maximal cardiopulmonary responses were not different, but submaximal exercise changes were elevated breathing CO. Thus, in healthy young men residing near 1600 m, an increase in low-level CO exposure produced a linear decrement in maximal aerobic performance similar to that reported at sea level. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N80-25002*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DECISION-PROBLEM STATE ANALYSIS METHODOLOGY

Duncan L. Dieterly May 1980 21 p refs Prepared in cooperation with AFHRL, Moffett Field, Calif.
(NASA-TM-81194; AFHRL/H/80-102) Avail: NTIS HC A02/MF A01 CSCL 05J

A methodology for analyzing a decision-problem state is presented. The methodology is based on the analysis of an incident in terms of the set of decision-problem conditions encountered. By decomposing the events that preceded an unwanted outcome, such as an accident, into the set of decision-problem conditions that were resolved, a more comprehensive understanding is possible. All human-error accidents are not caused by faulty decision-problem resolutions, but it appears to be one of the major areas of accidents cited in the literature. A three-phase methodology is presented which accommodates a wide spectrum of events. It allows for a systems content analysis of the available data to establish: (1) the resolutions made, (2) alternatives not considered, (3) resolutions missed, and (4) possible conditions not considered. The product is a map of the decision-problem conditions that were encountered as well as a projected, assumed set of conditions that should have been considered. The application of this methodology introduces a systematic approach to decomposing the events that transpired prior to the accident. The initial emphasis is on decision and problem resolution. The technique allows for a standardized method of accident into a scenario which may used for review or the development of a training simulation. R.E.S.

N80-25003*# SRI International Corp., Menlo Park, Calif. Artificial Intelligence Center.
RESEARCH IN INTERACTIVE SCENE ANALYSIS Final Report
Jay M. Tenenbaum 30 May 1980 49 p refs
(Contract NASw-2865)
(NASA-CR-163196) Avail: NTIS HC A03/MF A01 CSCL 05J

The recovery of information about the three dimensional structure and physical characteristics of surfaces depicted in an image was studied focusing on two complementary problems: (1) basic techniques for inferring three dimensional surface shape from two dimensional images and (2) means for integrating the results of different techniques to obtain a globally consistent surface description. A technique was developed for constraining surface orientation along image contours that correspond to surface boundaries. A means for interpolating surface orientation estimates from a variety of sources into smooth surfaces--a major integration problem--was also developed. A computational model, based on these techniques, was proposed for inferring the three dimensional surface structure depicted in a line drawing. R.E.S.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N80-25004# Grumman Aerospace Corp., Bethpage, N.Y.
INVESTIGATION OF MINIMUM SIZED LOW-PROFILE COCKPITS (MSLPC) AND CREW ESCAPE SYSTEM INTEGRATION Final Report, 15 Sep. 1978 - 17 Jul. 1979
William C. Tauby Wright-Patterson AFB, Ohio AFFDL 17 Sep. 1979 239 p refs
(Contract F33615-78-C-3427; AF Proj. 2402)
(AD-A081055; AFFDL-TR-79-3104) Avail: NTIS HC A11/MF A01 CSCL 01/3

Assessed are the potential benefits derived from the application to advanced fighter aircraft configurations and the integration of an effective crew escape capability. Alternate approaches and escape concepts were identified and subjected to analysis and tradeoff to permit the recommendation of preferred concepts. The computer simulation of escape system aerodynamic performance facilitated the evaluation leading to the selection of the supine concept as that preferred for further development as a preliminary design. GRA

N80-25005# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario). MLSD Div.
EVALUATION OF UK PQ OXYGEN MASK FOR USE IN CF AIRCRAFT
D. F. Leben Sep. 1979 27 p refs
(AD-A079476; DCIEM-79-R-39) Avail: NTIS HC A03/MF A01 CSCL 06/11

As part of a project to develop adequate life support equipment for the New Fighter Aircraft (NFA), evaluation of the Royal Air Force (RAF) P/Q oxygen mask by DCIEM indicated that the RAF P/Q mask is the only mask capable of holding the necessary 70-80 mm of pressure of the 'get-me-down' requirement of the life support ensemble. Subsequently, DCIEM was asked to evaluate the suitability of the P/Q mask as a direct replacement for the A13A mask (also known as the MS22001) for general use with the present series of aircrew helmets (i.e., the DH 41-2 jet aircrew helmet). The A13A oxygen mask currently in use in the CAF Air Operations has a number of deficiencies (e.g., slippage under G). Additionally, the A13A is not suited for use in the NFA (i.e., it cannot seal against the requisite positive breathing pressures for high altitude). This report documents the result of this evaluation. The P/Q is superior to all other oxyen masks available in that it is the only mask which can hold the 70-80 mm of pressure deemed necessary for the 'get-me-down' capability of the New Fighter Aircraft. In comparison, the A13A mask with Pate suspension can hold only 30 mm. GRA

N80-25006# Naval Postgraduate School, Monterey, Calif.
A SIMULATOR EVALUATION OF PILOT RESPONSE TO AN AIRCRAFT COCKPIT SPIN INDICATOR SYSTEM M.S. Thesis
James Hunter Aldrich, Jr. Dec. 1979 112 p refs
(AD-A081536) Avail: NTIS HC A06/MF A01 CSCL 01/3

A high-performance aircraft simulator facility employing a two-axis combat maneuvering simulation was used to investigate pilot response to an aircraft cockpit spin indicator system. The time required to correctly respond to departed flight, spin and engine stall indications was measured using F-14 NATOPS procedures. Incorrect and inadequate responses were also recorded. Quantitative and qualitative analysis of sixteen data items was performed for eighteen test subjects during twenty-seven test runs and compiled using eight category classifications. Favorable performance and opinion were obtained. Detailed conclusions and recommendations are presented. GRA

N80-25007# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
DYNAMICS OF MULTI-BODY SYSTEMS
I. H. Multi Nov. 1979 31 p refs
(AD-A082436; DME-MK-29; NRC-18017) Avail: NTIS HC A03/MF A01 CSCL 20/11

The dynamic equations of multi-body systems in the form of open chains are derived by applying the principles of linear and angular momentum to each individual member in the chain. This results in the appearance of constraint forces and torques in the dynamic equations. Using more or less classical approach these unknown forces and torques can be eliminated. Another approach is to approximate these forces by elastic and viscous forces by allowing small violations of the constraints. The well-known elimination procedure leads to a small densely coupled system of equations while the lesser-known procedure of approximating the constraint forces and torques yields a large but less densely coupled system. Both these procedures are first explained in the context of a single rigid body and then applied to a system of rigid bodies in an open chain where each body is coupled directly to at most two neighbors. GRA

N80-25008# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
LIVE SUBJECT EJECTION TOWER TESTING TO DETERMINE HUMAN TOLERANCE TO AN INCREASED ONSET RATE OF ACCELERATION Final Report, Jun. 1970 - Oct. 1972
W. C. Ward, Jr. 31 Oct. 1979 24 p
(WF41451402)
(AD-A082993; NADC-79244-60) Avail: NTIS HC A02/MF A01 CSCL 01/3

The U.S. Navy development of an advanced Minimal

Envelope/Weight (MEW) ejection seat under the auspices of AIR-340, Naval Air System Command (NASC), had as one of its design goals the development of a pure rocket motor as the propulsion system. The finalized propulsion unit produced an acceleration onset of 500 G/sec, which exceeded the specification maximum onset rate of 250 G/sec. As a consequence, this study was generated to determine whether the higher onset in combination with a 10 to 12 G acceleration was physiologically acceptable. This report describes the tests conducted in exploration of physiological acceptability of this particular acceleration envelope. The results indicate successful tolerance based on limited exposure of four volunteer subjects. GRA

N80-24685*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE TERRESTRIAL RADIATION ENVIRONMENT AND EVA'S: PREDICTION REQUIREMENTS, MODEL IMPROVEMENTS, AND WARNING SYSTEMS
E. G. Stassinopoulos *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 119-120
(For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 05H

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering*.

N80-25009*# Hughes Aircraft Co., Fullerton, Calif.
DESIGN OF A MODULAR DIGITAL COMPUTER SYSTEM Final Summary Report
30 Jan. 1980 48 p
(Contract NAS8-27926)
(NASA-CR-161457) Avail: NTIS HC A03/MF A01 CSCL 09B

A Central Control Element (CCE) module which controls the Automatically Reconfigurable Modular System (ARMS) and allows both redundant processing and multi-computing in the same computer with real time mode switching, is discussed. The same hardware is used for either reliability enhancement, speed enhancement, or for a combination of both. E.D.K.

N80-25010*# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
A POLYMORPHIC RECONFIGURABLE EMULATOR FOR PARALLEL SIMULATION Annual Report
E. A. Parrish, Jr., E. S. McVey, and G. Cook Apr. 1980 89 p refs
(Grant NsG-1599)
(NASA-CR-163185; UVA/528173/EE80/102) Avail: NTIS HC A05/MF A01 CSCL 09B

Microprocessor and arithmetic support chip technology was applied to the design of a reconfigurable emulator for real time flight simulation. The system developed consists of master control system to perform all man machine interactions and to configure the hardware to emulate a given aircraft, and numerous slave compute modules (SCM) which comprise the parallel computational units. It is shown that all parts of the state equations can be worked on simultaneously but that the algebraic equations cannot (unless they are slowly varying). Attempts to obtain algorithms that will allow parallel updates are reported. The word length and step size to be used in the SCM's is determined and the architecture of the hardware and software is described. J.M.S.

N80-25011# Sperry Univac, Roseville, Minn.
DATA BASE COMPUTER RESEARCH Final Report, 1 Sep. 1978 - 31 Aug. 1979
Harvey A. Freeman, J. Banerjee, R. B. Batman, O. H. Bray, H. R. Johnson, J. R. Jordan, J. L. Larson, T. M. P. Lee, D. B Russell, and T. B. Wilson 30 Nov. 1979 120 p refs
(Contract N00014-78-C-0487)
(AD-A082074; TMA-00789) Avail: NTIS HC A06/MF A01 CSCL 09/2

Data base computer research was undertaken by Sperry Univac to confirm the benefits of the DBC approach, and to determine the actual requirements of a data base computer from a computer manufacturer's point of view. Described in this report are an application investigation and analysis effort, a revised and extended data base computer design, the required software structure, a performance analysis, and some access control and security considerations. The result is a framework for a special purpose computer that will significantly improve the user's ability to manage the ever growing body of data characteristic of our modern technological society. GRA

N80-25012# Illinois Univ. at Urbana-Champaign. Coordinated Science Lab.
JETS: ACHIEVING COMPLETENESS THROUGH COVERAGE AND CLOSURE
Tim Finin, Bradley Goodman, and Harry Tennant 8 Feb. 1979 27 p refs
(Contract N00014-75-C-0612)
(AD-A081957; WP-19) Avail: NTIS HC A03/MF A01 CSCL 05/8

Work in progress on JETS, the successor to PLANES, is described. JETS is a natural language question answering system that is intended to interface users to a large relational data base. The architecture is designed to extend the conceptual coverage of JETS to better meet the conversational and data base usage requirements of users. The implementation of JETS is designed to gain a high degree of closure over concept manipulation, contributing to a solution to the problems of perspicuity and scale. Specific examples are given of concept manipulation through the implied relationships of modification and of an approach to problem-solving through the use of frames. GRA

N80-25013# Ohio State Univ. Research Foundation, Columbus.
FINITE STATE MODELS OF MANNED SYSTEMS: VALIDATION, SIMPLIFICATION AND EXTENSION Annual Report, 1 Oct. 1978 - 30 Sep. 1979
Richard A. Miller Nov. 1979 139 p ref
(Grant AF-AFOSR-0015-79; AF Proj. 2312)
(AD-A082434; AFOSR-80-0216TR) Avail: NTIS HC A07/MF A01 CSCL 09/2

Three basic research objectives were pursued. An assessment of the robustness and validity of previously developed discrete control models resulted in a comprehensive examination of the conceptual and methodological issues associated with validity. This work is included in the report. Work on computer assisted discrete control analysis focused primarily on the problems associated with representing continuous data in a form suitable for use by existing analysis routines. Additional work on modelling discrete control tasks, including modelling coordination in small trams was also performed and resulted in two papers which are included as appendices to the report. GRA

N80-25014# California Univ., Livermore. Lawrence Livermore Lab.

S-1 PROJECT: DEVELOPING HIGH-PERFORMANCE DIGITAL COMPUTERS
L. C. Widdoes, Jr. 11 Dec. 1979 12 p refs Presented at the COMPCON Spring 1980 Meeting, San Francisco, Feb. 1980; sponsored by the IEEE Computer Soc.
(Contract W-7405-eng-48)
(UCRL-83702; CONF-800201-5) Avail: NTIS HC A02/MF A01

The design and implementation of a multiprocessor (the S-1) with at least ten times the computational power of the Cray-1 is described. The multiprocessor is made up of 16 of these uniprocessors, sharing a main memory. The uniprocessors can be used together for large problems or separately for several smaller problems. To reduce average memory-access time, each uniprocessor has a private cache memory. A powerful design system (SCALD) that supports extremely efficient structured design of digital logic was also developed. Using advanced compiler and verification techniques, SCALD can complete the details of a computer design starting from a high-level specification. DOE

N80-25015# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
A DIGITAL LOW FREQUENCY SPECTRUM ANALYZER, USING A PROGRAMMABLE POCKET CALCULATOR
W. P. Spruit Jun. 1978 37 p refs
(TH-78-E-85; ISBN-90-6144-085-8) Avail: NTIS HC A03/MF A01

A measuring instrument utilizing Texas Instruments calculators (SR 52 or SR 56) is described. An application as a digital noise measuring system is discussed in detail. The instrument makes use of an input-output processor for the SR 52/56, developed by Verkroost, for which the design and testing of print lay-outs are reported. Results concerning sine-wave and noisy input signals are presented. For this application, the system shows no significant differences in properties with respect to the analog filters normally used for audio frequencies. The frequency range is, however, restricted to about 0.1 Hz, upper limit. Author (ESA)

N80-25016# Laboratorio di Ricerca e Technologia per lo Studio del Plasma nello Spazio, Frascati (Italy).
DATA ACQUISITION SYSTEM BASED ON THE RCA 1802 MICROCOMPUTER [SISTEMA DI ACQUISIZIONE DATI BASATO SUL MICROCALCOLATORE RCA 1802]
P. Cerulli-Irelli Jul. 1978 44 p refs Partly in ITALIAN and ENGLISH
(LPS-79-7) Avail: NTIS HC A03/MF A01

A data acquisition system is described. The system was implemented by adding to the RCA cosmac evaluation kit CDP 185020 an EPROM 2716 containing the BASIC interpreter, an EPROM 2716 with software for input-output management, an output gate of 8 bits in parallel, and an 8 bit A-D converter with 16 input channels. Author (ESA)

N80-25017# Royal Signals and Radar Establishment, Malvern (England).
MACHINE INDEPENDENT COMPILER FOR ATLAS (MICA)
D. P. Taylor London HMSO Apr. 1979 16 p refs
(RSRE-Memo-3167; BR67746) Avail: NTIS HC A02/MF A01

A number of software modules and a software building technique, known as a Machine Independent Compiler for 'ATLAS' (MICA) are described. The Abbreviated Test Language for All Systems (ATLAS) is a high-level computer language convenient for writing test specifications. Some language handling software systems shown include a translator, compiler, cross-compiler, interpreter, and assembler. The concept of MICA as a collection of computer programs and fully developed manual as well as automatic techniques which potentially enable an ATLAS compiler to be constructed for any project is then presented.
Author (ESA)

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N80-25018*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
COMPUTER PROGRAM DOCUMENTATION: RAW-TO-PROCESSED SINDA PROGRAM (RTOPHS) USER'S GUIDE
S. J. Damico Apr. 1980 10 p
(Contract NAS9-15800)
(NASA-CR-160654; LEMSCO-14880; JSC-16673) Avail: NTIS HC A02/MF A01 CSCL 09B

Use of the Raw to Processed SINDA(System Improved Numerical Differencing Analyzer) Program, RTOPHS, which provides a means of making the temperature prediction data on binary HSTFLO and HISTRY units generated by SINDA available to engineers in an easy to use format, is discussed. The program accomplishes this by reading the HISTRY unit and according to user input instructions, the desired times and temperature prediction data are extracted and written to a word addressable drum file. E.D.K.

N80-25019*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
COMPUTER PROGRAM DOCUMENTATION: ODRC DEMAND PLOTTING PROGRAM USER'S GUIDE
S. J. Damico Apr. 1980 39 p
(Contract NAS9-15800)
(NASA-CR-160653; JSC-16664; LEMSCO-14847) Avail: NTIS HC A03/MF A01 CSCL 09B

The Orbital Data Reduction Center (ODRC) Demand Plotting Program provides the user with three main options, each of which provides the additional option of generating a numerical summary and/or plots for the Measurement ID's (MID) on the Measurement Node Correlation (MNC) list. Option one reads MID data from word addressable ODRC files, stores the data on a temporary file, and uses it to build the numerical summary and/or plots, according to user input instructions. Options two and three read MID data from a word addressable ODRC file and component node data from a word addressable HSTFLO or HISTRY file. The component node data is used to calculate a predicted MID. Then, for option two, the MID and predicted MID data is used to generate a numerical summary and/or plots. For option three, the component node data itself is used in generating the numerical summary and/or plots. The numerical summary is sent to the BRKPT file, RELOCOK, and can be viewed after the execution of the program using the edit mode to find the desired section of the summary. E.D.K.

N80-25020*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
COMPUTER PROGRAM DOCUMENTATION D1FLTD TO DRIVE SINDA BOUNDARY NODES: USER'S GUIDE
S. J. Damico Apr. 1980 8 p refs
(Contract NAS9-15800)
(NASA-CR-160652; LEMSCO-14846; JSC-16663) Avail: NTIS HC A02/MF A01 CSCL 09B

The thermal model correlation process begins when measured thermocouple data is available from the orbital flight tests of the shuttle. For this effort, it is necessary to convert some of the system improved numerical differencing analyzer (SINDA) diffusion or arithmetic nodes to boundary nodes and then drive these boundary nodes to the temperature profile of a flight measurement. An efficient way to provide this capability within the SINDA and OFT software systems is to provide a new SINDA routine, D1FLTD, for use in VARIABLES 1 of SINDA, to access the processed (word-addressable) orbital data reduction center flight data and store the appropriate measurement temperature in the desired SINDA temperature location. The ODRC flight data that is to be used for driving the boundary nodes must be assigned a logical unit number and must reside on a word-addressable file. The user must also provide two SINDA constants for the word positions of the first and last words of the temperature record for each measurement identifier (MID), i.e. each call to D1FLTD, used in the model. D1FLTD is then called from the VARIABLES 1 block to obtain the SINDA boundary node temperature for any MID on the file at any time point. A.R.H.

N80-25021*# Science Systems and Applications, Inc., Lanham, Md.
A COMPUTER ALGORITHM FOR PERFORMING INTERAC-

TIVE ALGEBRAIC COMPUTATION ON THE GE IMAGE-100 SYSTEM Final Report
William D. Hart and H. H. Kim 1979 32 p refs
(Contract NAS5-25113)
(NASA-CR-159985) Avail: NTIS HC A03/MF A01 CSCL 09B

A subroutine which performs specialized algebraic computations upon ocean color scanner multispectral data is presented. The computed results are displayed on a video display. The subroutine exists as a component of the aircraft sensor analysis package. The user specifies the parameters of the computations by directly interacting with the computer. A description of the conversational options is also given. M.G.

N80-25022# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
AN ALTRAN PROGRAM FOR FINDING A RECURSION FORMULA FOR THE GEGENBAUER MOMENTS OF A FUNCTION
Neil Robertson Jul. 1979 62 p refs
(CSIR-SR-SWISK-12) Avail: NTIS HC A04/MF A01

An ALTRAN program is described that constructs a recurrence relation for the Gegenbaure moments of a function. The algorithm is expressed in terms of a certain type of linear operator. The implementation of the algorithm on to the ALTRAN language is described. M.G.

N80-25023# Naval Postgraduate School, Monterey, Calif.
A PORTABLE THREE-DIMENSIONAL COMPUTER GRAPHICS SOFTWARE PACKAGE M.S. Thesis
Homer John Rood, Sr. Sep. 1978 273 p refs
(AD-A081037) Avail: NTIS HC A12/MF A01 CSCL 09/2

A portable three-dimensional computer graphics software package was developed utilizing the FORTRAN language. The package included the capability of displaying any object as a wire-frame image, as a wire-frame image with hidden lines removed, or as a solid figure with hidden surfaces removed. This computer graphics package provides the user with the ability to rotate, scale, and translate any part of the displayable image. It was utilized to display images or four distinct display devices with only minor software alterations. Three totally different host computer supported the four display devices. GRA

N80-25024# Stanford Univ., Calif. Electronics Lab.
DESIGN AND VERIFICATION OF RELIABLE SOFTWARE Final Report, 1 Jan. 1977 - 31 Dec. 1979
Susan S. Owicki 29 Feb. 1980 13 p refs
(Contract F49620-77-C-0045; AF Proj. 2304)
(AD-A082545; AFOSR-80-0232TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

This research project is concerned with methods for developing provably correct concurrent programs. Two complementary approaches have been pursued. The first is the development of basic tools for describing and verifying concurrent interactions between system components. Specification and proof methods have been developed for both invariant properties and service guarantees of modular programs. They allow independent verification of each module, and provide a basis for reasoning about a wide class of concurrent systems. Statemeogic, a logical system in which one can reason about the future states of a program computation. GRA

N80-25025# University of Southern California, Marina del Rey. Information Sciences Inst.
MICROCODE VERIFICATION PROJECT Interim Report
Stephen D. Crocker, Leo Marcus, and Dono Van-Mierop Jan. 1980 63 p refs
(Contract F30602-78-C-0008; AF Proj. 5581)
(AD-A082461; RADC-TR-79-353) Avail: NTIS HC A04/MF A01 CSCL 09/2

The goal of the microcode verification project at ISI is the development of both the theory and tools for verification of microcode. The strategy has been to push the development of a working system, letting the theoretical issues and the human engineering questions emerge during system development. The ISPS language is used for encoding our machine descriptions. The State Delta formalism is used for reasoning about the course of the computation. A system to check proofs of microcode validity is currently built. The system is composed of a data base and simplifier that perform some automatic deductions to make checking of the proofsteps manageable, as well as a proof language and a user interface. A particular computer (the FTSC) is used to establish a focus for the project and to provide a source of examples. This document reports the results of verifying the microcode of the square root instruction of the FTSC, and the results of verifying the complete microcode of a much smaller fictitious example machine. GRA

N80-25026# Oak Ridge National Lab., Tenn. Chemistry Div.
COMPUTER-GENERATED ILLUSTRATIONS
C. K. Johnson 1979 10 p refs
(Contract W-7405-eng-26)
(DOE/TIC-11057) Avail: NTIS HC A02/MF A01

The computer graphics technique is one of the best available methods for analyzing and communicating complex results revolving crystallographic structural information. The types of commercial equipment available for use in crystallographic computer graphics and the commitment needed from the user of typical operational configurations are discussed. The Oak Ridge Crystallographic Imaging and Graphics System is given as an example configuration for stepwise interactive graphics and image processing. The applications of computer graphics to crystallography described are density map representation, particularly by critical point networks, and the drawing of crystal structures. The various types of line drawings and surface illustrations currently in use are discussed, and two solutions of the hidden line problem for thermalellipsoid drawings are compared. DOE

N80-25027# Sandia Labs., Livermore, Calif. Computer Applications Div.
QPLOT: A LIBRARY OF FORTRAN SUBROUTINES FOR QUICK LOOK DATA GRAPHING
H. G. Short Nov. 1979 23 p
(Contract EY-76-C-04-0789)
(SAND-79-8278) Avail: NTIS HC A02/MF A01

A set of FORTRAN compatible data plotting subroutines, QPLOT, provides a simplified method of data representation for those applications that do not require presentation quality graphics. It is a stand alone plot package and does not require knowledge of any other graphics software system. DOE

N80-25028# Royal Aircraft Establishment, Farnborough (England).
A USER'S GUIDE TO THE RAE GRAPH PLOTTER LIBRARY
B. E. Taylor London HMSO Jul. 1979 192 p refs
(RAE-TR-79098; RAE-Math-Comp-234; BR71045) Avail: NTIS HC A09/MF A01

The graph plotter library written to meet Royal Aircraft Establishment requirements for the production of drawings, graphs, and charts is described. The library is intended for use with either the ICL 1934 range of incremental drum plotters or the Calcomp 905/936 incremental drum plotter. The utilization of the library is shown and specifications of the routines contained in the library are given. Author (ESA)

N80-25029# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Numerical Analysis and Computing Science.
MICROPROGRAMMED FAST FOURIER TRANSFORM FOR THE VARIAN V73 AND ITS APPLICATION IN INTERACTIVE PICTURE PROCESSING
Magnus Persson 1979 31 p refs
(TRITA-NA-7915) Avail: NTIS HC A03/MF A01

A Fast Fourier Transform machine was designed and implemented on a Varian V73 minicomputer by means of microprogramming. The machine consists of eight transform instructions and five miscellaneous ones. The implementation is discussed and a detailed description of the Fast Fourier Transform machine itself is given. Some examples of use of the machine in digital picture processing are shown. Simple digitized pictures and their corresponding power spectra are displayed. A few filtering operations on a digitized picture indicate the capability of the machine. The utilization of the machine in an interactive environment is discussed and a computer architecture for digital picture processing, is suggested. Author (ESA)

N80-25030# Stichting Mathematisch Centrum, Amsterdam (Netherlands).
CHECKING LANDAU'S GRUNDLAGEN IN THE AUTOMATH SYSTEM
L. S. vanBenthemJutting 1979 133 p refs
(MCT-83; ISBN-90-6196-147-5) Avail: NTIS HC A07/MF A01; Stichting Math. Centrum, Amsterdam FL 15

An account of the translation of E. Landau's book Grundlagen der Analysis into AUTOMATH language is given. The version of this language used, AUT-QE, is formally defined and described in detail. Specific difficulties encountered in making the translation are discussed and the strategies applied to overcome them are shown. Results substantiate the claim that formalization and verification can really be carried out for substantial portions of mathematics with a language more closely resembling intuitive mathematics than other present day formalizations, and which is fit for describing a large variety of concepts and situations. Author (ESA)

N80-25031# Stichting Mathematisch Centrum, Amsterdam (Netherlands).
ALGOL 68 TRANSPUT. PART 2: AN IMPLEMENTATION MODEL
J. C. vanVliet 1979 230 p refs
(MCT-111; ISBN-90-6196-179-3) Avail: NTIS HC A11/MF A01; Stichting Math. Centrum, Amsterdam FL 27

An implementation model of the ALGOL 68 transput is reviewed. It is scrutinized to ensure that it correctly interprets the transput as defined. This model is shown to be an effective basis for actual implementation of the transput. Author (ESA)

N80-25032# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Operations Research.
EFFICIENT IMPLEMENTATION OF DYNAMIC PROGRAMMING ALGORITHMS FOR SEQUENCING PROBLEMS
E. L. Lawler (California Univ. Berkeley) May 1979 19 p refs Submitted for publication Sponsored in part by NATO (Grant NSF MCS-76-17605)
(MC-BW-106/79) Avail: NTIS HC A02/MF A01; Stichting Math. Centrum, Amsterdam FL 2.88

Dynamic programming is shown to be a fruitful approach for the solution of a variety of sequencing problems, including single machine sequencing problems and assembly line balancing problems. Certain technical difficulties experienced in fully exploiting the reduction in computational complexity which should result from the existence or precedence constraints in these problems are addressed. In particular, a satisfactory technique for generating 'feasible' sets of jobs, as determined by precedence constraints is considered. A simple computer implementation of the dynamic programming algorithms which overcase these difficulties is present. The implementation permits sequencing problems with precedence constraints to be solved in O (kn) time, where k is the number of feasible sets, and in O (n+k sub max) space, where k sub m is the number of feasible sets of size m and k sub max = max sub m k sub m. It is also shown how similar techniques can be applied to improve the efficiency of dynamic programming computations for the traveling salesman problem when the network is sparse or when there are precedence constraints. Author (ESA)

N80-25033# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Computer Science.
THE INSTALLATION OF ALICE ON THE PDP 11/45 UNDER UNIX
A. P. W. Boehm Jan. 1978 70 p refs
(MC-IW-94/78) Avail: NTIS HC A04/MF A01; Stichting Math. Centrum, Amsterdam FL 6.72

The implementation of ALICE on the PDP 11/45 under UNIX is discussed. The ALICE to assembly language translator and the run time system are described. The performance of the implementation is compared to C, the system implementation language of UNIX. Results show that the efficiency of the calling mechanism implementation is sufficient. Author (ESA)

N80-25034# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Computer Science.
A W-GRAMMAR OF ALEPH
R. Glandorf, D. Grune, and J. Verharen Nov. 1978 38 p refs
(MC-IW-100/78) Avail: NTIS HC A03/MF A01; Stichting Math. Centrum, Amsterdam FL 5.00

A VW-grammar (2 level grammar) of the programming language ALEPH is presented. It comprises a context-free grammar, plus all static restrictions. Some comments on the problems encountered in writing and debugging a W-grammar are given. This paper should be read in parallel with the ALEPH manual, since by itself it does not define or explain the language. Author (ESA)

N80-25035# Royal Aircraft Establishment, Farnborough (England).
CREATION AND MODIFICATION OF FLOW CHARTS USING AN INTERACTIVE GRAPHICS SYSTEM
G. Sharples London HMSO Sep. 1979 68 p refs
(RAE-TR-79113; RAE-Math-Comp-235; BR71907) Avail: NTIS HC A04/MF A01

A system for creating, storing, and modifying flow charts using a Vector General display linked to a PDP 11 minicomputer is described. On completion the flow charts can be directed to a plotter, the resulting output being suitable for inclusion in reports or documentation. Author (ESA)

62 COMPUTER SYSTEMS

Includes computer networks.

N80-25036# California Univ., Livermore. Lawrence Livermore Lab.
HIERARCHICALLY STRUCTURED DISTRIBUTED MICROPROCESSOR NETWORK FOR CONTROL
J. R. Greenwood, F. W. Holloway, P. R. Rupert, R. G. Ozarski, and G. J. Suski 6 Jul. 1979 13 p Presented at the 13th Rocky Mountain Symp., Fort Collins, Colo., 19-21 Aug. 1979 (Contract W-7405-eng-48)
(UCRL-82936; CONF-7908104-1) Avail: NTIS HC A02/MF A01

To satisfy a broad range of control analysis, and data acquisition requirements for Shiva, a hierarchical, computer based, modular distributed control system was designed. This system handles the more than 3000 control elements and 1000 data acquisition units in a severe high voltage, high current environment. The control system design gives one a flexible and reliable configuration to meet the development milestone for Shiva within critical time limits. DOE

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N80-25037 Stanford Univ., Calif.
SIMULATING GENERALIZED SEMI-MARKOV PROCESSES Ph.D. Thesis
Lawrence Duane Fossett 1980 105 p
Avail: Univ. Microfilms Order No. 8011636

The generalized semi-Markov process (GSMP) supplements the natural description of a system by adding information about the past history of the system. If a queueing network occupies a state where only one event can change the state of the system, the process behaves the same way each time it leaves this state. For GSMPs without such a state, stringent assumptions are required on the supplementary variables to develop a central limit theorem for the GSMP. By endowing the GSMP with a memory of a finite number of steps, an iterate of its transition function can be split into a state invariant measure and a state dependent remainder. These measures can be used to define a regenerative process which has a coordinate with the same marginal distribution as the original GSMP, however, it is not suitable for simulation applications because the remainder cannot be determined explicitly in most cases. A supplementary variables technique is developed which requires only a sequence of Bernoulli

random variables. The central limit theorem and variance estimation technique developed, provided a method of determining confidence intervals for functions of the equilibrium behavior of many complex stochastic systems. Dissert. Abstr.

N80-25038*# Massachusetts Inst. of Tech., Cambridge. Information and Decision Systems Lab.
ROBUSTNESS PROPERTIES OF DISCRETE TIME REGULATORS, LOG REGULATORS AND HYBRID SYSTEMS Final Report
Gunter Stein and Michael Athans 31 Oct. 1979 69 p refs (Grant NsG-1312)
(LIDS-FR-960; NASA-CR-163313) Avail: NTIS HC A04/MF A01 CSCL 12A

Robustness properites of sample-data LQ regulators are derived which show that these regulators have fundamentally inferior uncertainty tolerances when compared to their continuous-time counterparts. Results are also presented in stability theory, multivariable frequency domain analysis, LQG robustness, and mathematical representations of hybrid systems. J.M.S.

N80-25039*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REALIZABLE OPTIMAL CONTROL FOR A REMOTELY PILOTED RESEARCH VEHICLE
H. J. Dunn May 1980 35 p refs
(NASA-TP-1654; L-13403) Avail: NTIS HC A03/MF A01 CSCL 01C

The design of a control system using the linear-quadratic regulator (LQR) control law theory for time invariant systems in conjunction with an incremental gradient procedure is presented. The incremental gradient technique reduces the full-state feedback controller design, generated by the LQR algorithm, to a realizable design. With a realizable controller, the feedback gains are based only on the available system outputs instead of being based on the full-state outputs. The design is for a remotely piloted research vehicle (RPRV) stability augmentation system. The design includes methods for accounting for noisy measurements, discrete controls with zero-order-hold outputs, and computational delay errors. Results from simulation studies of the response of the RPRV to a step in the elevator and frequency analysis techniques are included to illustrate these abnormalities and their influence on the controller design. Author

N80-25040# Brown Univ., Providence, R. I. Lefschetz Center for Dynamical Systems.
A COMPARISON OF NUMERICAL METHODS FOR IDENTIFICATION AND OPTIMIZATION PROBLEMS INVOLVING CONTROL SYSTEMS WITH DELAYS
H. T. Banks, J. A. Burns (Virginia Polytechnic Inst. and State Univ.) E. M. Cliff (Virginia Polytechnic Inst. and State Univ.). Nov. 1979 189 p refs Prepared in cooperation with Virginia Polytechnic Inst. and State Univ.
(Contract DAAG29-79-C-0161; Grants AF-AFOSR-3092-76; DAAG29-78-G-0125; NSF MCS-79-05774; AF Proj. 2304)
(AD-A082151; LCDS-TR-79-7; AFOSR-80-0146TR) Avail: NTIS HC A09/MF A01 CSCL 12/1

This report presents numerical results for two approximation techniques for functional differential control systems. One technique is based on an averaging scheme, the other on spline approximations. A number of examples are considered and the techniques are applied to parameter estimation problems and optimal control problems where the systems are given by differential equations with hereditary terms. GRA

N80-25041# Old Dominion Univ., Norfolk, Va. Dept. of Electrical Engineering.
RESULTS ON CUMULANT CONTROL AND ESTIMATING SYSTEMS. A SUMMARY Final Report, 16 May 1978 - 31 Dec. 1979
Stanley R. Liberty and Clifford R. Parten Mar. 1980 16 p refs
(Contract N00014-78-C-0443)
(AD-A082077) Avail: NTIS HC A02/MF A01 CSCL 12/1

A description of a previously unpublished linear stochastic control problem class called 'cumulant control' is presented. A summary of an 'accessible state' formulation of problems in this class is given. This result is key to the applicability of this generalized Linear-Quadratic-Gaussian theory. GRA

N80-25042# California Univ., Santa Barbara. Inst. of Algebra and Combinatorics.
BASIC RESEARCH IN THE MATHEMATICAL FOUNDATIONS OF STABILITY THEORY, CONTROL THEORY AND NUMERICAL LINEAR ALGEBRA Annual Scientific Report, 1 Oct. 1978 - 30 Sep. 1979
Marvin Marcus, Morris Newman, Robert C. Thompson, Roy B. Leipnik, and Henryk Minc Sep. 1979 25 p refs
(Contract F49620-78-C-0030; AF Proj. 2304)
(AD-A082067; AFOSR-80-0166TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Research under the following general headings was concluded: (1) Eigenvalue inequalities (Marcus, Thompson); (2) Numerical range calculations (Marcus); (3) Exact solutions of integral systems of linear equations (Newman); (4) Experiments on the ILLIAC IV, Sunnyvale, CA (Newman); (5) The Campbell Baker Hausdorff formula (Thompson); (6) Rearrangement inequalities and determinant bounds (Minc); (7) Non-linear control in 3 x 3 linear systems (Leipnik). GRA

N80-25043# Massachusetts Inst. of Tech., Cambridge. Information and Decision Systems Lab.
RECENT DEVELOPMENTS IN THE ROBUSTNESS THEORY OF MULTIVARIABLE SYSTEMS. PROCEEDINGS OF THE ONR/MIT WORKSHOP Final Report
Nils R. Sandell, Jr., ed. 31 Aug. 1979 457 p refs Workshop held in Cambridge, Mass., 25-27 Apr. 1979
(Contract N00014-79-C-0377)
(AD-A082362; LIDS-R-954; ONR-CR-215-271-1F) Avail: NTIS HC A20/MF A01 CSCL 12/1

This report summarizes the recent developments in the Robustness Theory of Multivariable Systems. The motivation for the workshop was the dissemination and discussion of recent research results concerning the characterization of robust multivariable feedback systems, defined here as systems that perform satisfactorily despite differences between the mathematical model used for control synthesis and the actual dynamics, and the design of such systems. The report describes the motivation for the theoretical developments and the nature of the results that have been obtained. An introductory discussion of the papers presented at the workshop is provided; the papers themselves are included in an Appendix. Finally, the research directions identified in a roundtable discussion held at the end of the workshop are summarized. GRA

N80-25044# Stanford Univ., Calif. Dept. of Operations Research.
REGENERATIVE SIMULATION OF RESPONSE TIMES IN NETWORKS OF QUEUES
Donald L. Iglehart and Gerald S. Shedler Nov. 1979 211 p refs
(Contract N00014-76-C-0578; Grants NSF MCS-75-23607; NSF MCS-79-09139; NR Proj. 042-343)
(AD-A082736; SU-TR-52) Avail: NTIS HC A10/MF A01 CSCL 12/2

Networks of queues occur frequently in diverse applications. In particular, they are widely used in studies of computer and communication system performance as models for the interactions among system resources. This monograph deals with mathematical and statistical methods for discrete event simulation of networks of queues. The emphasis is on methods for the estimation of general characteristics of 'passage times' in closed networks. Informally, a passage time is the time for a job to traverse a portion of a network. Such quantities, calculated as random sums of queueing times, are important in computer and communication system models where they represent job response times. GRA

N80-25045# Los Alamos Scientific Lab., N. Mex.
ADAPTIVE OPTIMAL CONTROL: AN ALGORITHM FOR DIRECT DIGITAL CONTROL
Donald R. Farris and Thomas E. McDonald 1980 32 p refs Presented at the Semiann. Meeting of ASHRAE, Los Angeles, 3-7 Feb. 1980
(Contract W-7405-eng-36)
(LA-UR-79-1897; CONF-800206-1) Avail: NTIS

HC A03/MF A01

An algorithm developed for applying advanced control concepts in heating, ventilating, and air conditioning systems is described. The algorithm uses optimal control and is adaptive in nature. Simulations for a solar heated and cooled building indicate that use of this algorithm can accomplish a substantial savings in auxiliary energy consumption. Its application is illustrated with a simple example. Simulation results for a more complex system are presented. The hardware, including the digital computer, needed to implement this algorithm is briefly discussed. DOE

N80-25048# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Automatic Control.

EXPERIMENT DESIGN FOR MAXIMUM-POWER MODEL VALIDATION

Ludomir Rewo 1979 27 p refs

(TRITA-REG-7902) Avail: NTIS HC A03/MF A01

The problem of input signal selection for the testing of dynamic models is considered and the specific maximum power used is described. Some computational aspects are discussed and a simple example is given. Author (ESA)

N80-25047# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Automatic Control.

THE MULTILEVEL RANDOM WALK BETWEEN REFLECTING BARRIERS: A NEW TYPE OF TEST SIGNAL FOR THE IDENTIFICATION OF NONLINEAR PROCESSES

N. A. Lindberger 1979 45 p refs

(TRITA-REG-7903) Avail: NTIS HC A03/MF A01

The generalized multilevel random walk between symmetric reflecting barriers is defined as a random walk process which allows jumps between any pair of a finite number of discrete levels with probabilities specified by a Markov matrix, as distinguished from the simple random walk commonly described in the literature in which jumps are allowed only to adjoining levels. The simple, as well as the generalized processes, are analyzed with respect to their covariance and spectral properties. It is shown that, in this respect, in spite of their nonlinear feature of having a limited amplitude they are spectrally equivalent to the linear autoregressive moving-average stochastic process. The amplitude limitation gives them an advantage over the autoregressive moving-average process for use as test signals for dynamical systems. Concerning suitability for identification it turns out in case studies that almost any stable realization allows for linear parameter estimation with high accuracy, without any noticable trends of differences in quality between the different signal families that can be obtained by the choice of transition probabilities in the stochastic matrix. Author (ESA)

N80-25048# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Operations Research.

COMPUTATION OF THE STATIONARY DISTRIBUTION OF THE QUEUE SIZE IN AN M/G/1 QUEUEING SYSTEM WITH VARIABLE SERVICE RATE

A. Federgruen and H. C. Tijms (Free Univ., Amsterdam) Jan. 1979 11 p refs Submitted for publication

(MC-BW-97/79) Avail: NTIS HC A02/MF A01; Stichting Math. Centrum, Amsterdam FL 6

A simple and computationally tractable method which recursively computes the stationary probabilities of the queue size in an M/G/1 queueing system with variable service rate is presented. For each service two possible service types are available and the service rule is characterized by two switch-over levels. Results show that the computational approach discussed can be applied to a variety of queueing problems. Author (ESA)

N80-25049# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Operations Research.

A UNIFIED STEADY-STATE ANALYSIS FOR CONTROLLED MARKOV DRIFT PROCESSES IN INVENTORY, QUEUEING AND REPLACEMENT PROBLEMS

H. C. Tijms Jan. 1979 13 p refs Submitted for publication

(MC-BW-98/79) Avail: NTIS HC A02/MF A01; Stichting Math. Centrum, Amsterdam FL 3

A simple and unified approach for the steady-state analysis of a class of controlled Markov drift processes involving compound Poisson processes and arising in various applications areas, such as inventory production, queueing, and replacement systems, is presented. Three specific problems are studied. These are a finite capacity queueing-storage problem with variable input and output rates, a finite capacity production-inventory problem with variable demand and production rates, and a replacement problem under additive damage with variable damaging rates. In these problems the drift parameters of the underlying stochastic processes can be controlled, while the control rule considered is characterized by two switchover levels. Results are used to find a formula for the long run average expected costs per unit time. This also leads to the definition of operating characteristics, the stationary probability distribution of the state of the system, and the average number of switchovers and overflows per unit time.

Author (ESA)

N80-25050# Stichting Mathematisch Centrum, Amsterdam (Netherlands).

PREEMPTIVE SCHEDULING OF UNIFORM PARALLEL MACHINES TO MINIMIZE THE WEIGHTED NUMBER OF LATE JOBS

E. L. Lawler (California Univ., Berkeley) May 1979 23 p refs Submitted for publication Sponsored in part by NATO

(Grant NSF MCS-76-17605)

(MC-BW-105/79) Avail: NTIS HC A02/MF A01; Stichting Math. Centrum, Amsterdam FL 2.88

The possibility of preemptively scheduling n jobs on m uniform parallel machines so as to minimize the weighted number of late jobs in time of O(W exp 2 N exp 2), for M = 2, and of O(W exp 2, n exp (3m-5), for M > or = 3, where W is the sum of the integer weights of the jobs is shown. For fixed m this constitutes a pseudopolynomial time bound, and for fixed m and unweighted jobs i.e., W = n, a strictly polynomial time bound. It is also shown that for fixed m there is a fully polynomial approximation scheme. Preemptive scheduling procedures are then derived to which dynamic programming techniques are applied. Run time results confirm the validity of the scheduling scheme.

Author (ESA)

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N80-25051 Stanford Univ., Calif.

ALGORITHMIC EQUIVALENCE IN QUADRATIC PROGRAMMING Ph.D. Thesis

Arthur Diang 1980 213 p

Avail: Univ. Microfilms Order No. 8011626

Algorithms for solving the quadratic programming problem (QP) of minimizing a real valued quadratic function subject to linear inequality constraints is considered. The case of problem QP in which the objective function f(x) is strictly convex is examined. A method called the active set algorithm is described, and a number of procedures for solving QP are shown to be realizations of the method and are therefore equivalent. The case in which f(x) is a general quadratic function is also discussed. The relationship between active set methods and pivoting algorithms for general quadratic programming is discussed, and additional equivalence results are proved. A special case of QP known as the least distance programming problem is examined. For this problem relationships among active set, pivoting, and simplicial decomposition algorithms are demonstrated.

Dissert. Abstr.

N80-25052 Texas Univ. at Austin.

A PENALTY METHOD FOR THE FINITE ELEMENT ANALYSIS OF CERTAIN UNILATERAL PROBLEMS IN VON KARMAN PLATE THEORY Ph.D. Thesis

Kunihiko Ohtake 1979 169 p

Avail: Univ. Microfilms Order No. 8009906

Penalized variational equations governing a class of nonlinear plate problems with unilateral contact conditions are formulated using the von Karman theory of large deflections of elastic plates. Two classes of problems are considered, the plate with fixed edges, and the problem of simply supported plates with thrust. Existence, uniqueness and regularity of solutions to these problems are discussed based on pseudomonotone operator theory. A finite

element approximation scheme is proposed based on penalty arguments. The convergence of approximate solutions to solutions of the variational problems is proved. A computational method is introduced which employs Fraeijs de Veubeke's plate bending element, a Newton-Raphson iteration scheme, and a penalty method. The results of several numerical experiments are given which indicate that the methods developed are quite effective for problems of this type. Dissert. Abstr.

N80-25053 Catholic Univ. of America, Washington, D. C.
IMPROVEMENT OF THE CONSTRAINED VARIATIONAL METHOD Ph.D. Thesis
Frederick Albert Schumann 1980 76 p
Avail: Univ. Microfilms Order No. 8010941

A method for the approximate solution of boundary value differential equations and the extension of an existing variational method that provides a solution for secondary variables and derivatives in addition to the primary variable(s) is discussed. Both methods are categorized as constrained variational methods. The first method, Galerkin with constraints, utilizes Lagrangian multipliers as holonomic constraints to provide for all boundary conditions that are not satisfied by the selected trial function. The second method employs Lagrangian multipliers as non-holonomic constraints that introduce additional variables or derivatives of variables to the same formulation. The constrained Galerkin method is not limited to a conservative system. The applied differential operators of interest need not be either self adjoint or positive definite. The exact solution of a base problem is also not required. Thus the field of applicable problems is significantly enhanced. Dissert. Abstr.

N80-25054*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF A MULTI-LEVEL GRID METHOD TO TRANSONIC FLOW CALCULATIONS
Jerry C. South, Jr. and Achi Brandt (Weizmann Inst. of Science) 19 Mar. 1976 30 p refs
(Grant NGR-47-102-001)
(NASA-TM-81066; ICASE-76-8) Avail: NTIS HC A03/MF A01 CSCL 12A

A multi-level grid method was studied as a possible means of accelerating convergence in relaxation calculations for transonic flows. The method employs a hierarchy of grids, ranging from very coarse to fine. The coarser grids are used to diminish the magnitude of the smooth part of the residuals. The method was applied to the solution of the transonic small disturbance equation for the velocity potential in conservation form. Nonlifting transonic flow past a parabolic arc airfoil is studied with meshes of both constant and variable step size. E.D.K.

N80-25055*# Santa Clara Univ., Calif. Dept. of Mechanical Engineering.
ON ONE-DIMENSIONAL STRETCHING FUNCTIONS FOR FINITE-DIFFERENCE CALCULATIONS Final Technical Report, 1 Jul. 1978 - 30 Jun. 1979
Marcel Vinokur 1979 55 p refs
(Grant NsG-2086)
(NASA-CR-163136) Avail: NTIS HC A04/MF A01 CSCL 12A

The class of one-dimensional stretching functions used in finite-difference calculations is studied. For solutions containing a highly localized region of rapid variation, simple criteria for a stretching function are derived using a truncation error analysis. These criteria are used to investigate two types of stretching functions. One is an interior stretching function, for which the location and slope of an interior clustering region are specified. The simplest such function satisfying the criteria is found to be one based on the inverse hyperbolic sine. The other type of function is a two-sided stretching function, for which the arbitrary slopes at the two ends of the one-dimensional interval are specified. The simplest such general function is found to be one based on the inverse tangent. A.R.H.

N80-25056*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
INVERSION AND APPROXIMATION OF LAPLACE TRANSFORMS
William M Lear (TRW) 19 May 1980 37 p
(NASA-TM-81084; JSC-16499; Rept-80-FM-20) Avail: NTIS HC A03/MF A01 CSCL 12A

A method of inverting Laplace transforms by using a set of orthonormal functions is reported. As a byproduct of the inversion, approximation of complicated Laplace transforms by a transform with a series of simple poles along the left half plane real axis is shown. The inversion and approximation process is simple enough to be put on a programmable hand calculator. E.D.K.

N80-25057*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DISCRETE TCHEBYCHEFF ORTHONORMAL POLYNOMIALS AND APPLICATIONS
W. M. Lear (TRW) Apr. 1980 59 p
(NASA-TM-81065; JSC-16484; Rept-80-FM-19) Avail: NTIS HC A05/MF A01 CSCL 12A

Discrete Tchebycheff orthonormal polynomials offer a convenient way to make least squares polynomial fits of uniformly spaced discrete data. Computer programs to do so are simple and fast, and appear to be less affected by computer roundoff error, for the higher order fits, than conventional least squares programs. They are useful for any application of polynomial least squares fits: approximation of mathematical functions, noise analysis of radar data, and real time smoothing of noisy data, to name a few. E.D.K.

N80-25058# Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics.
ITERATIVE ELLIPSOIDAL TRIMMING
Laurence S. Gillick Feb. 1980 139 p Prepared in cooperation with Northeastern Univ., Boston, Mass.
(Contract N00014-75-C-0555)
(AD-A082238; TR-15) Avail: NTIS HC A07/MF A01 CSCL 12/1

The iterative ellipsoidal trimming algorithm is introduced as both a clustering method and an estimator of location and shape. Its power as a data analytic tool is investigated and the asymptotic distribution of its stationary point is derived. In addition, several scale estimators are proposed and studied. GRA

N80-25059# Wisconsin Univ. - Madison. Dept. of Statistics.
USE OF BOX-COX TRANSFORMATION WITH BINARY RESPONSE MODELS
V. M. Guerrero and Richard A. Johnson Aug. 1979 12 p refs
(Contract N00014-78-C-0722)
(AD-A080911; UWIS-DS-79-575) Avail: NTIS HC A02/MF A01 CSCL 12/1

The power transformation is applied to the odds ratio to generalize the logistic model and to parameterize a certain type of lack of fit. Transformation of the design variable within the context of the dose-response problem is also considered. GRA

N80-25060# Systems and Applied Sciences Corp., Riverdale, Md.
AN INVESTIGATION OF THREE METHODS OF COMPLETING A STAGGERED DATA FIELD ON A SQUARE GRID
Donald C. Norquist 24 Aug. 1979 26 p ref
(Contract F19628-79-C-0033; AF Proj. 6670; AF Proj. 2310)
(AD-A082330; SCIENTIFIC-1; AFGL-TR-79-0197) Avail: NTIS HC A03/MF A01 CSCL 12/1

Three methods are examined for estimating values for grid points without data, based on data values available at grid points distributed in a staggered manner on a square grid. One method uses the average of values at surrounding points. The other two involve interpolation formulas of greater sophistication: bicubic spline interpolation and Fourier transform interpolation. All three methods are applied to square grids on which values of transcendental functions of known wave numbers are placed in a staggered fashion. The completed fields from each method are spectrally analyzed to determine the effect of the completion method on the known spectrum of the incomplete field. It is determined that all three methods tend to alias high wave number components to lower wave number components. In addition, a spectral spreading is observed in the bicubic spline technique. The Fourier transform method results in the least amount of aliasing, especially when the incomplete field is made up primarily of low wave number components. GRA

N80-25061# Wisconsin Univ. - Madison. Dept. of Computer Sciences.
ANOTHER LOOK AT ITERATIVE METHODS FOR ELLIPTIC DIFFERENCE EQUATIONS
Seymour V. Parter and Michael Steuerwalt (LASL) Jul. 1979 29 p refs
(Contracts N00014-76-C-0341; W-7405-eng-36)
(AD-A082391; CSTR-358; LA-UR-80-202) Avail: NTIS HC A03/MF A01 CSCL 12/1

Iterative methods for solving elliptic difference equations have received new attention because of the recent advent of novel computer architectures and a growing interest in three dimensional problems. The fundamental characteristic of an iterative method is its rate of convergence. We present here, in the context of the model problem in two and three dimensions, a very simple theory for determining the rates of convergence of block iterative schemes. This theory is easily extended to general domains, general elliptic problems, and higher dimensions. GRA

N80-25062# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
NECESSARY AND SUFFICIENT CONDITIONS FOR OPTIMAL CONTROL OF QUASILINEAR PARTIAL DIFFERENTIAL SYSTEMS
N. A. Derzko (Toronto Univ.), S. P. Sethi (Toronto Univ.), and G. L. Thompson Nov. 1979 32 p refs
(Contracts N00014-75-C-0621; N00014-76-C-0932)
(AD-A082422; MSRR-453) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper studies the problem of optimal control of quasilinear partial differential systems. A maximum principle necessary condition is derived and shown to be sufficient when the Hamiltonian and boundary conditions satisfy a convexity condition. The derivation is made using Stokes theorem and a generalized version of Green's theorem. Management science applications are suggested to problems of cattle ranching, perishable inventories, manpower planning, and advertising. GRA

N80-25063# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
A SEMIGROUP APPROACH TO PARTIAL DIFFERENTIAL EQUATIONS WITH DELAY
Karl Kunisch Feb. 1980 20 p refs
(Grant AF-AFOSR-3092-76; AF Proj. 2304)
(AD-A082070; AFOSR-80-0145TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The objective of this investigation is to give sufficient conditions on f and g such that local semigroups can be associated with the equation (1). This will imply representation formulas for the solutions of (1), and secondly to discuss various notions of solutions which have arisen in the study of (1). Although only the autonomous equation is considered here, many of the results remain true if f and g depend on t. GRA

N80-25064# Claremont Mens Coll., Calif. Inst. of Decision Science
DELTA-EXACT LOWER CONFIDENCE BOUNDS FOR SERIES AND PSEUDO-SERIES SYSTEM RELIABILITY
Tim Baker, Renee Clift, Beth Karras, Austin Lee, Amanda McZeal, and Alexis Oliver Feb. 1980 31 p refs
(Contract N00014-78-C-0213)
(AD-A082133; Rept-80-1) Avail: NTIS HC A03/MF A01 CSCL 12/1

Methods of computing lower confidence bounds are examined for applicability to actual data and systems. Improvements to a modification of the likelihood ratio method are shown for the series case and a variety of methods are studied for pseudo-series, which may model some missiles. GRA

N80-25065# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOME k-TH ORDER SOLUTIONS TO THE PROBLEM OF FINDING OPTIMAL DISCRIMINANT FUNCTIONS
Lee K. Jones 10 Jan. 1980 23 p refs
(Contract F19628-80-C-0002; AF Proj. 627A)
(AD-A082396; TN-1980-4; ESD-TR-79-305) Avail: NTIS HC A02/MF A01 CSCL 12/1

This article describes a general method for discriminating between two random variables when we are required to use a discriminant function belonging to a given class. GRA

N80-25066# Texas Univ. at Austin. Center for Cybernetic Studies.
POLYEXTREMAL PRINCIPLES AND SEPARABLY-INFINITE PROGRAMS
A. Charnes, P. Gribik (Pacific Gas and Electric Co., San Francisco), K. Kortanek (Carnegie-Mellon Univ.), and A. Levine Jan. 1980 46 p refs
(Contract N00014-75-C-0569; Grant NSF ENG-78-25488; NR Proj. 047-021)
(AD-A081943; CCS-RR-346) Avail: NTIS HC A03/MF A01 CSCL 12/1

As a direct extension of Charnes' characterization of two-person zero-sum constrained games by linear programming, it is shown how a general class of saddle value problems can be reduced to a pair of uniextremal dual separably-infinite programs. These programs have an infinite number of variables and an infinite number of constraints, but only a finite number of variables appear in a infinite number of constraints and only a finite number of constraints have an infinite number of variables. The conditions under which the characterization holds are among the more general ones appearing in the literature sufficient to guarantee the existence of a saddle point of concave-convex function. The key construction involves augmenting a given player's original set of variables by generalized finite sequences determined by the other player's constraint set and objective function. A duality theory is developed which includes complementarity conditions, thereby making contact with the numerical treatment of semi-infinite program. GRA

N80-25067# Texas Univ. at Austin. Center for Cybernetic Studies.
COMPREHENSIVE COMPUTER EVALUATION AND ENHANCEMENT OF MAXIMUM FLOW ALGORITHMS
Fred Glover (Colorado Univ., Boulder), Darwin Klingman, John Mote (Analysis, Research, and Computation, Inc., Austin, Texas), and David Whitman (Analysis, Research, and Computation, Inc., Austin, Texas) Oct. 1979 80 p refs
(Contracts N00014-78-C-0222; DOT-OS-70074)
(AD-A081941; CCS-RR-356) Avail: NTIS HC A05/MF A01 CSCL 12/2

The primary purpose of this study was to refine and streamline all major classes of maximum flow algorithms using the recent developments in network labeling and data organization techniques. To safeguard against being swayed too heavily by preliminary analyses (and past experience in other network settings), it has implemented more than one type of data structure and associated processing techniques for most of the algorithms. Additionally, the resulting codes on four distinct problem topologies has been tested. GRA

N80-25068# Naval Postgraduate School, Monterey, Calif.
FORMATION OF EFFICIENT FINITE ELEMENT PREDICTION MODELS Technical Report, Oct. 1978 - Dec. 1979
R. T. Williams and A. L. Schoenstadt Jan. 1980 37 p refs
(Contracts N66856-79-WR-79002; N63134-79-WR-90909)
(AD-A081945; NPS63-80-001) Avail: NTIS HC A03/MF A01 CSCL 12/1

This report compares three finite element formulations of the linearized shallow-water equations which are applied to the geostrophic adjustment process. The three corresponding finite difference schemes are also included in the study. The development follows Schoenstadt (1980) wherein the spatially discretized equations are Fourier transformed in x, and then solved with arbitrary initial conditions. The six schemes are also compared by integrating them numerically from an initial state at rest with a height perturbation at a single point. The finite difference and finite element primitive equation schemes with unstaggered grid points give very poor results for the small scale features. The staggered scheme B gives much better results with both finite differences and finite elements. The vorticity-divergence system with unstaggered points also is very good with finite differences and finite elements. It is especially important to take into account these results when formulating efficient finite element prediction models. GRA

N80-25069# Brown Univ., Providence, R. I. Div. of Applied Mathematics.

A COMPARISON OF NUMERICAL METHODS FOR IDENTIFICATION AND OPTIMIZATION PROBLEMS INVOLVING CONTROL SYSTEMS WITH DELAYS

H. T. Banks and J. A. Burns Nov. 1979 189 p refs

(Contract DAAG29-79-C-0161; Grants DAAG29-78-G-0125; AF-AFOSR-3092-76; NSF MCS-79-05774)

(AD-A081986; ARO-15561.6-M; ARO-16835.2-M) Avail: NTIS HC A09/MF A01 CSCL 12/1

Numerical results are presented for two approximation techniques for functional differential control systems. One technique is based on an averaging scheme, the other on spline approximations. A number of examples are considered and the techniques are applied to parameter estimation problems and optimal control problems where the systems are given by differential equations with hereditary terms. GRA

N80-25070*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

APPLICATION OF THE METHOD OF LINES TO THE SOLUTION OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS APPLICATION Aeronautical Report

D. J. Jones and J. C. South, Jr. Ottawa National Research Council of Canada Nov. 1979 82 p refs In ENGLISH; FRENCH summary Prepared in cooperation with National Aeronautical Establishment, Ottawa, Canada

(NASA-TM-80982; AD-A082729; NAE-LR-599; NRC-18021) Avail: NTIS HC A05/MF A01 CSCL 12/1

The method of lines is used in this report for solving one linear, two nonlinear elliptic boundary value problems and a linear eigenvalue problem. An analysis of the stability and convergence is made in the linear cases. GRA

N80-25071# Utah Univ., Salt Lake City. Dept. of Mathematics.

AN AUTOMATIC QUADRATURE ALGORITHM BASED ON THE TRAPEZOIDAL FORMULA

J. Schwing (Old Dominion Univ., Norfolk, Va.) and K. Sikorski 22 Feb. 1980 28 p refs

(Grant DAAG29-77-G-0139)

(AD-A082547; ARO-14864.7-M) Avail: NTIS HC A03/MF A01 CSCL 12/1

The formulas that this subroutine (WNEW) is based on are most powerful when the integrand f does not have a singularity (a singularity is a point where df/dx does not exist) in the interior of the range of integration; however, singularities at end-points of intervals are allowed. Indeed, it is in the cases where f has singularities at the end-points of the range of integration that the subroutine WNEW is superior to other subroutines. GRA

N80-25072# Oak Ridge National Lab., Tenn. Engineering Physics Div.

GENERALIZED SENSITIVITY THEORY FOR SYSTEMS OF COUPLED NONLINEAR EQUATIONS

D. G. Cacuci, C. F. Weber, E. M. Oblow, and J. H. Marable Jan. 1980 105 p refs

(Contract W-7405-eng-26)

(NUREG-CR-1003; ORNL/NUREG/TM-349) Avail: NTIS HC A06/MF A01

A general sensitivity theory is presented for treating problems characterized by systems of nonlinear equations with nonlinear responses. Frechet derivatives are used in both differential and variational approaches to derive appropriate adjoint equations and expressions for sensitivity functions. The two approaches are unified to form a complete operator viewpoint of sensitivity theory. Also presented is an alternative sensitivity formalism for systems of nonlinear matrix equations such as those arising from the application of numerical methods to many practical problems. This approach significantly enlarges the scope and versatility of sensitivity theory as it allows direct treatment of parameters which are purely of numerical methods origin. To demonstrate the usefulness and practical applications of both operator and matrix formalisms, a significantly nonlinear transient problem in fast reactor thermal-hydraulics is considered. DOE

N80-25073# Stanford Univ., Calif. Dept. of Computer Science.

PROJECTED LAGRANGIAN ALGORITHMS FOR NONLINEAR MINIMAX AND 1-SUB-1 OPTIMIZATION Ph.D. Thesis

M. L. Overton Aug. 1979 172 p refs Sponsored in part by the National Research Council of Canada

(Contract EY-76-S-03-0326; Grants NSF MCS-75-13497; NSF MCS-78-11985)

(SU-326-P3067) Avail: NTIS HC A08/MF A01

Algorithms for solving the nonlinear minimax and L sub 1 optimization problems are presented. The minimax problem can be transformed into a nonlinearly constrained optimization problem with one extra variable, where the objective and constraint functions are continuously differentiable. A direction of search is obtained at each iteration of the algorithm by solving an equality constrained quadratic programming problem, related to one a projected Lagrangian method might use to solve the equivalent constrained optimization problem. The L sub 1 problem can also be transformed into a nonlinearly constrained optimization problem, but it involves extra variables. A method closely related to that for the minimax problem which requires successively solving quadratic programs in the same number of variables as that of the original problem is constructed. Several flexible steplength algorithms are presented, along with algorithms for univariate minimization of the minimax, L sub 1 and related functions. DOE

N80-25074# California Univ., Livermore. Lawrence Livermore Lab.

MULTIGRID METHODS: AN ALTERNATE VIEWPOINT

S. F. McCormick Oct. 1979 23 p refs

(Contract W-7405-eng-48)

(UCID-18487) Avail: NTIS HC A02/MF A01

An operator theoretic approach to the multigrid process is presented with the view that the technique is a combined Newton like method and relaxation scheme. Attention is focused upon the correction cycle of this process. A simplified view of the multigrid processes is provided and some of the nuances of the techniques used in the full multigrid scheme are clarified. DOE

N80-25075# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Numerical Analysis and Computing Science.

SOME CONTRACTIVITY QUESTIONS FOR ONE-LEG AND LINEAR MULTISTEP METHODS

Germund Dahlquist 1979 14 p refs

(TRITA-NA-7905) Avail: NTIS HC A02/MF A01

The set of contractivity for a one leg method with respect to the norm generated by a positive definite k x k matrix is either a disk, a half plane, or the exterior of a disk. It can also degenerate into a point or be void. The result is a kind of converse to the main result of an analysis of the equivalence of G-stability to A-stability. Author (ESA)

N80-25076# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Numerical Mathematics.

A SEMI-DISCRETIZATION ALGORITHM FOR TWO-DIMENSIONAL PARTIAL DIFFERENTIAL EQUATIONS

J. Kok, P. J. vanderHouwen, and P. H. M. Wolkenfelt Dec. 1978 17 p refs

(MC-NW-54/78) Avail: NTIS HC A02/MF A01; Stichting Math. Centrum, Amsterdam FL 3

The semi-discretization method of a general class of nonlinear two dimensional time-dependent partial differential equations on a grid with nonuniform meshes is described. The documentation of the semi-discretization algorithm is then presented. Finally, the relation with other semi-discretization methods to be used together with different time-integrators for solving initial boundary value problems is indicated. Author (ESA)

N80-25077# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Numerical Mathematics.

BACKWARD DIFFERENTIATION FORMULAS FOR VOLTERRA INTEGRAL EQUATIONS OF THE SECOND KIND. PART 2: NUMERICAL EXPERIMENTS

H. J. J. TeRiele and P. J. vanderHouwen May 1978 25 p refs

(MC-NW-57/78-Pt-2) Avail: NTIS HC A02/MF A01; Stichting Math. Centrum, Amsterdam FL 3

Results of numerical experiments with backward differentiation formulas for linear and nonlinear Volterra integral equations of the second kind are given. In order to start these (multistep) formulas, a starting scheme is supplied based on extrapolation of the trapezoidal rule and combined with a block-implicit Runge-Kutta scheme. Convergence and stability tests were carried out and the efficiency is compared with that of a block-implicit Runge-Kutta scheme of de Hoog and Weiss. It is shown that the backward differentiation formulas are especially suitable for problems where the kernel has a large Lipschitz constant with respect to its last argument. Author (ESA)

N80-25078# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Applied Mathematics.

A CLASS OF PROBLEMS IN HYDRODYNAMICS

H. A. Lauwerier Mar. 1978 12 p refs

(MC-TW-175/78) Avail: NTIS HC A02/MF A01; Stichting Math. Centrum, Amsterdam FL 3

A number of problems in hydrodynamics which lead to elliptic partial differential equations with oblique boundary conditions are surveyed. These included the initial value problem for a shallow sea with an arbitrary geometry as well as the consideration of a semi-infinite channel bounded by coasts and an ocean. Mathematical models were developed and equations were obtained for a stationary situation, for free oscillations, and for periodic motion under the influence of an external periodic force. Author (ESA)

N80-25079# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Pure Mathematics.

ON THE NONEXISTENCE OF CERTAIN PLANAR SPACES

A. E. Brouwer Aug. 1978 15 p

(MC-ZW-114/78) Avail: NTIS HC A02/MF A01; Stichting Math. Centrum, Amsterdam FL 3

Whether or not, in a nontrivial planar space in which all planes are isomorphic to a given linear space, all lines have the same cardinality (unless the given linear space is a degenerate projective plane) is discussed. The six smallest given linear spaces for which this might be true are defined. Next, the impossibility of five of these six cases is shown by various counting arguments. A rather strong result on the parameters, implying the previous results, and some miscellaneous results on special classes of linear spaces are also brought out. Author (ESA)

N80-25080# Office of Personnel Management, Washington, D.C. Personnel Research and Development Center.

ESTIMATORS OF THE SQUARED CROSS-VALIDITY COEFFICIENT: A MONTE CARLO INVESTIGATION Final Technical Study.

Fritz Drasgow, Neil J. Dorans, and Ledyard R. Tucker Oct. 1979 15 p refs Prepared in cooperation with Illinois Univ. at Urbana-Champaign

(PB80-138928; TS-79-3) Avail: NTIS HC A02/MF A01 CSCL 12A

A Monte Carlo experiment was used to evaluate four procedures for estimating the population squared cross-validity of a sample least squares regression equation. Four levels of population squared multiple correlation (R[p] squared) and three levels of number of predictors (n) were factorially crossed of produce twelve population covariance matrices. Random samples at four level of sample size (n) were drawn from each population. The level of R[p] squared, n, and N were carefully selected to ensure relevance of simulation results for much applied research. The least squares regression equation from each sample was applied in its respective population to obtain the actual population squared cross-validity (R[cv] squared). GRA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N80-25081# California Univ., Berkeley. Operations Research Center.

INFERENCE FOR THE EXPONENTIAL LIFE DISTRIBUTION

Richard E. Barlow and Frank Proschan Dec. 1979 46 p refs Prepared in cooperation with Florida State Univ., Tallahassee.

(Grant AF-AFOSR-3179-77; AF Proj. 2304)

(AD-A080899; ORC-79-16) Avail: NTIS HC A03/MF A01 CSCL 14/4

This paper constitutes chapter 1 of a book on "Inference and Data Analysis for Reliability and Life Testing." The purpose is to provide an elementary coherent Bayesian foundation for research in statistical reliability theory. The results in section 3 and the appendix concerning the role of failures and total time on test in statistical inference for the exponential model are new. GRA

N80-25082# Wisconsin Univ. - Madison. Dept. of Statistics.

ON TESTING EQUALITY OF TWO EXPONENTIAL DISTRIBUTIONS UNDER COMBINED TYPE 2 CENSORING Interim Report

G. K. Bhattacharyya and Kishan G. Mehrotra (Syracuse Univ.) Jan. 1980 19 p refs

(Contract N00014-78-C-0722)

(AD-A080913; UWIS-DS-80-601) Avail: NTIS HC A02/MF A01 CSCL 12/1

The problem of testing equality of the scale parameters of two exponential distributions is considered under a combined sample type II censoring scheme that has been extensively treated in nonparametric inference. Sufficiency and invariance considerations lead to a pair of statistics, namely, the proportions of failure count and the total time on test of the first sample to those of the combined sample. Exact distribution and moment properties are discussed, and asymptotic joint normality under local alternatives is established in a general framework. The invariant test that maximizes the Pitman efficacy is seen to be based on the difference between these two proportions, and is asymptotically equivalent to the likelihood ratio test. GRA

N80-25083# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.

A DISTRIBUTED ALGORITHM FOR MINIMUM WEIGHT SPANNING TREES. REVISION

R. G. Gallager, P. A. Humblet, and P. M. Spira (Apple Computer Co.) Oct. 1979 24 p refs

(Contract N00014-75-C-1183; Grant NSF ENG-77-19971; ARPA Order 3045)

(AD-A080902; LIDS-P-908-A) Avail: NTIS HC A02/MF A01 CSCL 12/1

A distributed algorithm is presented that constructs the minimum weight spanning tree in a connected undirected graph with distinct edge weights. A processor exists at each node of the graph, knowing initially only the weights of the adjacent edges. The processors obey the same algorithm and exchange messages with neighbors until the tree is constructed. The total number of messages required for a graph of N nodes and E edges is at most 5 N log of N to the base 2 & 2 E and a message contains at most one edge weight plus log of 8 N to the base 2 bits. The algorithm can be initiated spontaneously at any node or at any subset of nodes. Author (GRA)

N80-25084# Pittsburgh Univ., Pa. Dept. of Mathematics and Statistics.

SOME CONCEPTS OF MULTIVARIATE DEPENDENCE

Henry W. Block and Mei-Ling Ting 1980 14 p refs

(Contract N00014-76-C-0839)

(AD-A082065; RR-79-02) Avail: NTIS HC A02/MF A01 CSCL 12/1

Several types of positive dependence are shown to be equivalent to the concept of a distribution with a density which is TP2 in pairs. Among these is the concept of m^*-positive dependence of Alam and Wallenius. Using this result, all relationships among many of the most important concepts of positive dependence are determined. Furthermore, an application of the equivalences of these types of positive dependence yields a result of Ahmed, Langberg, Leon and Proschan. GRA

N80-25085# Ohio State Univ., Columbus. Dept. of Statistics.

A MULTIVARIATE SOLUTION OF THE MULTIVARIATE RANKING AND SELECTION PROBLEM

Edward J. Dudewicz and Vidya S. Taneja (Univ. of Western Ill.)

Feb. 1980 23 p refs
(Contract N00014-78-C-0543)
(AD-A082035; TR-163A) Avail: NTIS HC A02/MF A01 CSCL 12/1

The problem of selection of the best multivariate population is given a new formulation which does not involve reducing the populations to univariate quantities. This formulation's solution is developed for known, and (using the Heteroscedastic Method) also for unknown, variance-covariance matrices. Preference reversals and arbitrary nonlinear preference functions are explicity allowed in this new theory. GRA

NSO-25086# Florida State Univ., Tallahassee. Dept. of Statistics.
THE EXTREMAL LARGE DEVIATION RATE OF THE F-STATISTIC
L. Barker and J. Sethuraman Oct. 1979 19 p refs
(Grant DAAG29-79-G-0278)
(AD-A081960; FSU-STATISTICS-M529; TR-D-42-ARO; ARO-16713.7-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

The extremal large deviation rate of the F-statistic over a large class is determined. It is shown that the Bahadur efficiency of the F-test relative to Moses' rank test for equality of variances is zero at every alternative when the distribution of the underlying observations is unspecified. GRA

NSO-25087# Virginia Polytechnic Inst. and State Univ., Blacksburg.
THE USE OF R AND S2 CHARTS UNDER NONSTANDARD CONDITIONS
D. R. Jensen and Y. V. Hui Mar. 1980 33 p refs
(Grant DAAG29-78-G-0172)
(AD-A083032; RR-Q-3; ARO-15194.3-M) Avail: NTIS HC A03/MF A01 CSCL 12/1

R and S-squared charts for monitoring the variability of a process are studied when the control variance, (sigma sub 0) squared is unknown, when observations are non-Gaussian, and when the process drifts. Geometric bounds on run-length distributions for the R and S-squared charts are given for all underlying distributions when (sigma sub 0) squared is estimated in a base period. Similar bounds apply in the case of a drifting process, the notion of which is developed rigorously. It is shown that normal-theory properties of these charts hold exactly for every spherical process when a suitable estimate for (sigma sub 0) squared is used. Run-length distributions otherwise are shown to be ordered stochastically given a peakedness ordering on the underlying spherical processes. GRA

NSO-25088# Rockwell International Science Center, Thousand Oaks, Calif.
EXTREME VALUE DISTRIBUTIONS Technical Report, 1 Feb. - 30 Jun. 1979
N. R. Mann and Nozer D. Singpurwalla Feb. 1980 25 p refs
Prepared in cooperation with George Washington Univ.
(Contracts N00014-76-C-0723; NRC-04-78-239; NR Proj. 047-204)
(AD-A082624; SC5065.4TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This is an expository survey of the univariate theory of extreme values and the estimation of the parameters of the related extreme-value distributions. This survey was written at the invitation of Professors N.L. Johnson and S. Kotz, editors of the forthcoming 'Encyclopedia of Statistical Sciences' to be published by John Wiley and Sons, Inc., New York. The theory of extreme values plays a fundamental role in several areas of applied statistics, such as the analysis of flood flows, the reliability of complex systems, the analysis of air pollution data, etc. In addition to surveying (without proofs) the basic results of extreme value theory and the estimators of the parameters of the extreme value distributions, this survey presents a brief discussion of the current research in these areas. GRA

NSO-25089# Stanford Univ., Calif. Dept. of Statistics.
APPROXIMATING CONDITIONAL MOMENTS OF THE MULTIVARIATE NORMAL DISTRIBUTION
Joseph G. Deken Dec. 1979 30 p refs
(Contract N00014-75-C-0442)
(AD-A082921; SU-TR-41) Avail: NTIS HC A03/MF A01 CSCL 12/1

A practical method for computing the conditional expectation of a polynomial in the components of a multivariate normal random variable X, when X is restricted to a subset of R superscript p, is given. This method makes the application of certain missing data techniques possible in cases where repeated numerical integration is not feasible. GRA

NSO-25090# Wisconsin Univ. - Madison. Dept. of Statistics.
ILL POSED PROBLEMS: NUMERICAL AND STATISTICAL METHODS FOR MILDLY, MODERATELY AND SEVERELY ILL POSED PROBLEMS WITH NOISY DATA
Grace Wahba Feb. 1980 75 p refs
(Contract N00014-77-C-0675)
(AD-A082925; UWIS-DS-80-595) Avail: NTIS HC A04/MF A01 CSCL 12/1

We discuss a number of topics related to the practical solution of ill posed problems given noisy data as it might arise in an experimental situation. The sensitivity of a regularized estimate of f to the noise is made explicit. After giving the intrinsic rank of the examples of first and second derivative, Abel's equation and Fujita's equation, it is argued that the first three are only mildly ill posed and f should be amendable to accurate estimation by the method of regularization. The method of Generalized Cross Validation (GCV) for choosing the regularization parameter is described and numerical results for the estimation of first and second derivative from noisy data are given. Two numerical algorithms for obtaining a regularized estimate with GCV are detailed. The second uses a B-spline basis to allow the handling of large data sets. This use of outside information in the estimation of f is discussed. We discuss the problem of checking the validity of the 'model' k, and provide a crude goodness-of-fit test. Finally we end by describing the (known) result that the number k of iterations in a Landweber iteration for solving large linear systems is a form of regularization parameter. We than show how GCV can feasibly be used to choose k in very large problems like those arising in computerized tomography. GRA

NSO-25091# Stichting Mathematisch Centrum, Amsterdam (Netherlands).
A SURVEY OF ASYMPTOTIC VALUE-ITERATION FOR UNDISCOUNTED MARKOVIAN DECISION PROCESSES
A. Federgruen and P. J. Schweitzer May 1979 46 p refs
Submitted for publication
(MC-BW-104/79) Avail: NTIS HC A03/MF A01; Stichting Math. Centrum, Amsterdam FL 3.85

The asymptotic behavior of undiscounted value-iteration in Markov decision problems with finite state and action spaces is reviewed. The asymptotic results concern both the value functions and the sets of optimizing policies as the length of the planning period tends to infinity. The discussion includes Lyapunov functions and other techniques for bounding a solution pair to the optimality equations

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

NSO-25092# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
THE NONCANDIDATE CONSTRAINT METHOD FOR REDUCING THE SIZE OF A LINEAR PROGRAM
Awanti P. Sethi and Gerald L. Thompson Feb. 1980 17 p refs
(Contract N00014-75-C-0621; NR Proj. 047-048)
(AD-A082423; MSRR-455; WP-52-79-80) Avail: NTIS HC A02/MF A01 CSCL 12/2

A noncandidate constraint in a linear program is one which never contains a pivot element during the course of solving the problem. Discovering noncandidate constraints is computationally costly since their discovery, in general, depends on the actual sequence of pivots used. Knowing which constraints are noncandidate is of great computational benefit since they need not be kept in updated form. Our experience indicates that from 50 to 80 percent of the constraints in random problems are

noncandidates at least part of the time. In this paper we present a learning approach to the identification of noncandidate constraints. At each iteration we determine which constraints can potentially be pivotal; these are candidate constraints and all others are noncandidate constraints on that step. On proceeding with the simplex method we update only the candidate constraints. If a noncandidate constraint becomes candidate on a later step, we update it and add it to the candidate list. Although the constant checking of constraints to see whether they are changing from being candidate to noncandidate is computationally costly, we obtain the computational benefit of having to keep in updated form a much smaller tableau. The net benefit of using this strategy is positive and results in a 25 to 50 percent reduction in total computation time. This paper describes the method in detail and gives computational results of testing it on a series of randomly generated problems. GRA

N80-25093# California Univ., San Diego, La Jolla. Dept. of Electrical Engineering and Computer Sciences.
COMBINATIONAL ALGORITHMS IN OPERATIONS RESEARCH Final Report, 1 Sep. 1975 - 31 Dec. 1979
T. C. Hu 10 Mar. 1980 6 p refs
(Grant DAAG29-76-G-0031)
(AD-A082614; ARO-12945.3-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

Nine technical papers and a manuscript of a book on 'Combinatorial Algorithms' were prepared. The most significant discoveries are two algorithms of constructing binary tree optimum under various criteria. The first algorithm constructs optimum binary trees which include Huffman's tree as a special case. The second algorithm constructs optimum alphabetic trees which include Hu-Tucker tree as a special case. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N80-25094# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
CONDITIONAL POSITIVITY OF QUADRATIC FORMS IN HILBERT SPACE
D. H. Martin Aug. 1979 25 p refs
(CSIR-TWISK-113) Avail: NTIS HC A02/MF A01

If X and Y are real Hilbert spaces (A : X approaches Y is a bounded linear operator, and gamma is contained in set Y is a closed convex cone) an immediate sufficient condition for a quadratic form Q on X to be positive subject to the constraint Ax is an element of gamma, is that Q be decomposable as a sum Q(x) = C(Ax) + S(x), where C is a quadratic form on Y which is positive on gamma, and S is positive definite on X. The necessity of such a decomposition is established for a class of quadratic forms which commonly occur in variational problems - the Legendre forms. The proof furnishes formulas for C and S which are explicit apart from the occurrence of an unkown scalar. The usefulness of the result is illustrated by the determination of the focal (conjugate) time of a linear-quadratic control problem with inequality constraints on the final state. M.G.

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N80-25095 Texas Univ. at Austin.
RESONANT PERIODIC ORBITS IN THE PROBLEM OF THREE BODIES Ph.D. Thesis
Hoi-Ming Kwok 1979 181 p
Avail: Univ. Microfilms Order No. 8009882

The evolution of families of resonant periodic orbits in the circular and elliptic restricted problem into families of the general problem is studied. A systematic approach is introduced to generate resonant periodic orbits in the circular, elliptic restricted and the general three-body problem. The bifurcation phenomena in the restricted problem are studied, analyzed and compared with the bifurcation phenomena in the general problem. A new method to determine the linear stability of periodic orbits of the general three-body problem by surfaces of section is introduced. The method calculates the characteristic exponents of a periodic orbit by using a nonrotating heliocentric coordinate system rather than the usual rotating coordinate system. The stability characteristics of families of resonant periodic orbits of the asteroidal type, especially of the Hecuba, Hilda and Thule groups, are analyzed. Two new families of periodic orbits with a 5:2 resonance and having the mass ratio of the Sun-Jupiter-Saturn system are found, and their stability characteristics are studied. A new type of bifurcation phenomenon in periodic orbits of the general three-body problem is discovered. Dissert. Abstr.

N80-25096# California Univ., Livermore. Lawrence Livermore Lab.
NONLINEAR DYNAMICS
J. C. Garrison 19 Nov. 1979 25 p refs
(Contract W-7405-eng-48)
(UCID-18499) Avail: NTIS HC A02/MF A01

This cursory survey of nonlinear physical phenomena describes some important problems and identifies common qualitative properties and analytical techniques. Brief descriptions nonequilibrium thermodynamics, turbulence, plasma physics, nonlinear optics, and nonlinear mechanics are presented. Similarities that exist between such apparently unrelated fields are remarked upon. DOE

N80-25097# California Univ., Livermore. Lawrence Livermore Lab.
RADIATION EFFECTS ON SUPERCONDUCTORS AND MAGNET STABILIZER MATERIALS
R. A. VanKonynenburg and M. W. Guinan Jan. 1980 8 p refs
(Contract W-7405-eng-48)
(UCID-18523) Avail: NTIS HC A02/MF A01

Previously irradiated Nb3Sn wires were given additional irradiation at room temperature to reach the anticipated serious decline in critical current and to evaluate the fluence where it occurs. An experiment is in preparation to measure the magnetoresistance of copper and aluminum in fields up to 12 tesla after 14MeV neutron irradiation, as well as testing the effects of repeated irradiation and room temperature annealing on NbTi critical current. DOE

N80-25098# Brookhaven National Lab., Upton, N. Y.
MANY-BODY PROBLEM IN ONE-DIMENSION
V. J. Emery Nov. 1979 35 p refs Presented at the 2nd Summer Inst. on Phys. of Low Dimensional Systems, Kyoto, Japan, 7-14 Sep. 1979
(Contract EY-76-C-02-0016)
(BNL-26960; CONF-7909119-1) Avail: NTIS HC A03/MF A01

Many-body systems in one dimension are examined and a particular strong-coupling model is considered. The model provides description of the chains of mercury ions in Hg/sub 3-delta/AsF6; some of the predictions of the theory can be checked by X-ray and neutron diffraction. Much of the physics of nearly one dimensional materials is concerned with understanding the possible types of phase transition that may take place, and establishing the conditions in which one or another will be predominant. The most significant feature of purely one dimensional systems is dominant effect of fluctuations. Qualitative aspects of one dimensional systems (qualitative discussion of strong coupling - strong attractive U, strong repulsive U, large V); strong coupling between parallel spins (independent spin systems, coupling between opposite spins); mercury chains; electrons with arbitrary coupling; boson representation of operators; and classical Coulomb gas are addressed. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N80-25099 New York Univ., N. Y.
CONSTRUCTIVE SOLUTION AND CHARACTERIZATION OF

INVERSE SCATTERING PROBLEM FOR THE ONE-DIMENSIONAL ACOUSTIC WAVE EQUATION Ph.D. Thesis
Robert Rex Greene 1979 120 p
Avail: Univ. Microfilms Order No. 8010358

The inverse scattering problem for the one dimensional acoustic wave equation on the real line is solved. The class of reflection coefficients of the wave equation is completely characterized for a class of wave speeds. The problem is solved using 'trace methods' tailored to the wave equation. 'Trace formulas' are derived which express the wave speed c, and the logarithmic derivative of c in terms of solutions of the wave equation and of the reflection coefficient. When these expressions are coupled to the wave equation, it is possible to solve the coupled 'trace system' to recover the wave speed from the reflection coefficient. Existence and uniqueness theorems for a solution of the trace system are proved. The trace method provides a differential equation approach to the solution of the inverse problem. Marchenko equations are derived which can be used to give an integral equation approach to the inverse problem.
Dissert. Abstr.

N80-25100*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ANALYSIS OF VIBRATORY EXCITATION OF GEAR SYSTEMS AS A CONTRIBUTOR TO AIRCRAFT INTERIOR NOISE
William D. Mark Feb. 1979 97 p refs
(Contract NAS1-14611)
(NASA-CR-159088; TM-502) Avail: NTIS HC A05/MF A01 CSCL 20A

Application of the transfer function approach to predict the resulting interior noise contribution requires gearbox vibration sources and paths to be characterized in the frequency domain. Tooth-face deviations from perfect involute surfaces were represented in terms of Legendre polynomials which may be directly interpreted in terms of tooth-spacing errors, mean and random deviations associated with involute slope and fullness, lead mismatch and crowning, and analogous higher-order components. The contributions of these components to the spectrum of the static transmission error is discussed and illustrated using a set of measurements made on a pair of helicopter spur gears. The general methodology presented is applicable to both spur and helical gears. A.R.H.

N80-25101*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A COMPARISON BETWEEN AN EXISTING PROPELLER NOISE THEORY AND WIND TUNNEL DATA
James H. Dittmar May 1980 41 p refs
(NASA-TM-81519; E-464) Avail: NTIS HC A03/MF A01 CSCL 20A

The noise of three supersonic helical tip speed propellers was compared with the noise predicted by an existing noise theory. Comparisons of the peak blade passage tones showed fairly good agreement between theory and experiment at the lowest helical tip Mach numbers tested, 0.86 and 1.00, while at higher numbers, the theory predicted higher noise levels than measured. When the differences among the propellers were considered the theory and measurement showed fairly good agreement. Directivity measurements in general showed that the measured blade passage tone data peaked further downstream than the theory predicted. At the cruise design condition the harmonics appeared to fall off faster in the data than the theory indicated. E.D.K.

N80-25102*# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
INTERIOR NOISE CONTROL PREDICTION STUDY FOR HIGH-SPEED PROPELLER-DRIVEN AIRCRAFT
D. C. Rennison, J. F. Wilby, A. H. Marsh (DyTec Eng., Inc., Long Beach, Calif.), and E. G. Wilby Sep. 1979 307 p refs
(Contract NAS1-15426)
(NASA-CR-159200; BBN-4026) Avail: NTIS HC A18/MF A01 CSCL 20A

An analytical model was developed to predict the noise levels inside propeller-driven aircraft during cruise at M = 0.8. The model was applied to three study aircraft with fuselages of different size (wide body, narrow body and small diameter) in order to determine the noise reductions required to achieve the goal of an A-weighted sound level which does not exceed 80 dB. The model was then used to determine noise control methods which could achieve the required noise reductions. Two classes of noise control treatments were investigated: add-on treatments which can be added to existing structures, and advanced concepts which would require changes to the fuselage primary structure. Only one treatment, a double wall with limp panel, provided the required noise reductions. Weight penalties associated with the treatment were estimated for the three study aircraft. J.M.S.

N80-25103*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SURFACE ACOUSTICAL INTENSITY MEASUREMENTS ON A DIESEL ENGINE
Michael C. McGary and Malcolm J. Crocker (Purdue Univ., West Lafayette, Ind.) Apr. 1980 18 p refs Presented at the 99th Acoust. Soc. of Am. Meeting, Atlanta, 21-25 Apr. 1980
(NASA-TM-81807) Avail: NTIS HC A02/MF A01 CSCL 20A

The use of surface intensity measurements as an alternative to the conventional selective wrapping technique of noise source identification and ranking on diesel engines was investigated. A six cylinder, in line turbocharged, 350 horsepower diesel engine was used. Sound power was measured under anechoic conditions for eight separate parts of the engine at steady state operating conditions using the conventional technique. Sound power measurements were repeated on five separate parts of the engine using the surface intensity at the same steady state operating conditions. The results were compared by plotting sound power level against frequency and noise source rankings for the two methods. Author

N80-25104*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME CALCULATED EFFECTS OF NON-UNIFORM INFLOW ON THE RADIATED NOISE OF A LARGE WIND TURBINE
George C. Greene and Harvey H. Hubbard May 1980 14 p refs
(NASA-TM-81813) Avail: NTIS HC A02/MF A01 CSCL 20A

Far field computations were performed for a large wind turbine to evaluate the effects of non-uniform aerodynamic loading over the rotor disk. A modified version of the Farassat/Nystrom propeller noise prediction program was applied to account for the variations in loading due to inflow interruption by the upstream support tower. The computations indicate that for the uniform inflow case, relatively low noise levels are generated and the first rotational harmonic dominated the spectrum. For cases representing wake flow deficiences due to the tower structure, subtantially increased noise levels for all harmonics are indicated, the greatest increases being associated with the higher order harmonics. Author

N80-25105*# Lockheed-California Co., Burbank.
ANALYTICAL STUDY OF INTERIOR NOISE CONTROL BY FUSELAGE DESIGN TECHNIQUES ON HIGH-SPEED, PROPELLER-DRIVEN AIRCRAFT Final Report, Jul. 1978 - Dec. 1979
J. D. Revell, F. J. Balena, and L. R. Koval 4 Apr. 1980 174 p refs Supersedes LR-29252
(Contract NAS1-15427)
(NASA-CR-159222; LR-29382; LR-29252) Avail: NTIS HC A08/MF A01 CSCL 20A

The acoustical treatment mass penalties required to achieve an interior noise level of 80 dBA for high speed, fuel efficient propfan-powered aircraft are determined. The prediction method used is based on theory developed for the outer shell dynamics, and a modified approach for add-on noise control element performance. The present synthesis of these methods is supported by experimental data. Three different sized aircraft are studied, including a widebody, a narrowbody and a business sized aircraft. Noise control penalties are calculated for each aircraft for two kinds of noise control designs: add-on designs, where the outer wall structure cannot be changed, and advanced designs where

the outer wall stiffness level and the materials usage can be altered. For the add-on designs, the mass penalties range from 1.7 to 2.4 percent of the takeoff gross weight (TOGW) of the various aircraft, similar to preliminary estimates. Results for advanced designs show significant reductions of the mass penalties. For the advanced aluminum designs the penalties are 1.5% of TOGW, and for an all composite aircraft the penalties range from 0.74 to 1.4% of TOGW. J.M.S.

N80-25106# Hamilton Standard, Windsor Locks, Conn. Systems Research and Development Service.
V/STOL ROTARY PROPULSOR NOISE PREDICTION MODEL UPDATE AND EVALUATION
B. Magliozzi Dec. 1979 237 p refs
(Contract DOT-FA77WA-4067)
(AD-A082516; FAA-RD-79-107) Avail: NTIS HC A11/MF A01 CSCL 20/1

A literature review was conducted to identify and evaluate high quality noise measurements of propeller, variable pitch fan, fixed pitch fan, helicopter, lift fan, core engine, and jet noise for the preparation of a data base with emphasis on recent measurements of in-flight propulsors. The effects of forward flight on V/STOL propulsor noise were evaluated and the noise prediction model was improved to give better agreement with current measurements. The performance of the noise prediction methodology was evaluated by comparison of calculations with measurements of propulsor noise from the data base. Although certain aspects of the measured propulsor noise, such as installation and ground reflection effects, caused discrepancies between measured and calculated levels (the calculations assume uninstalled propulsors under free-field conditions), the general correlation was good. Typical correlation between measured and calculated one third octave band levels was + or - 5 dB and between measured and calculated dB(A), PNL, PNLT, and EPNL was + or - 3 dB. A.R.H.

N80-25107# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
ULTRASONIC WAVE PROPAGATION IN MATERIALS WITH ORTHOTROPIC (ORTHORHOMBIC) SYMMETRY WITH AN EXAMPLE OF CENTRIFUGALLY CAST PIPE
D. W. Fitting, L. Adler, and K. V. Cook Feb. 1980 77 p ref
(Contract W-7405-eng-26)
(ORNL-5609) Avail: NTIS HC A05/MF A01

The propagation of elastic waves in orthotropic and hexagonal anisotropic material is examined mathematically showing that the elastic constants for these materials may be ascertained from ultrasonic longitudinal and transverse wave velocity measurements. Knowledge of the elastic constants of the material permits calculation of the velocities of longitudinal and transverse waves propagating in any direction. Experimental velocity measurements on samples of centrifugally cast austenitic stainless steel pipe are presented. They compare favorably with theoretical predictions, assuming an orthotropic model. DOE

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N80-25108*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MODIFIED ITERATIVE EXTENDED HUECKEL. 1: THEORY
S. Aronowitz Apr. 1980 26 p refs 2 Vol.
(NASA-TM-81200; A-8183) Avail: NTIS HC A03/MF A01 CSCL 20H

Iterative Extended Huekel is modified by inclusion of explicit effective internuclear and electronic interactions. The one electron energies are shown to obey a variational principle because of the form of the effective electronic interactions. The modifications permit mimicking of aspects of valence bond theory with the additional feature that the energies associated with valence bond type structures are explicitly calculated. In turn, a hybrid molecular, orbital valence, bond scheme is introduced which incorporates variant total molecular electronic density distributions similar to the way that Iterative Extended Hueckel incorporates atoms. Author

N80-25109*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MODIFIED ITERATIVE EXTENDED HUECKEL 2: APPLICATION TO THE INTERACTION OF Na(+), Na(+)(aq.), Mg(+)-2(aq.) WITH ADENINE AND THYMINE
S. Aronowitz, R. MacElroy, and S. Chang Apr. 1980 28 p refs 2 Vol.
(NASA-TM-81201; A-8184) Avail: NTIS HC A03/MF A01 CSCL 20H

Modified Iterative Extended Hueckel, which includes explicit effective internuclear and electronic interactions, is applied to the study of the energetics of Na(+),Mg(+), Na(+) (aqueous), and Mg(+2) (aqueous) ions approaching various possible binding sites on adenine and thymine. Results for the adenine + ion and thymine + ion are in good qualitative agreement with ab initio work on analogous systems. Energy differences between competing sites are in excellent agreement. Hydration appears to be a critical factor in determining favorable binding sites. That the adenine N1 and N3 sites cannot displace a water molecule from the hydrated cation indicates that they are not favorable binding sites in aqueous media. Of those sites investigated, O4 was the most favorable binding site on the thymine for the bare Na(+). However, the O2 site was the most favorable binding site for either hydrated cation. Author

N80-25110*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
QUANTUM THEORY AND CHEMISTRY: TWO PROPOSITIONS
S. Aronowitz May 1980 13 p refs
(NASA-TM-81202) Avail: NTIS HC A02/MF A01 CSCL 20J

Two propositions concerning quantum chemistry are proposed. First, it is proposed that the nonrelativistic Schroedinger equation, where the Hamiltonian operator is associated with an assemblage of nuclei and electrons, can never be arranged to yield specific molecules in the chemists' sense. It is argued that this result is a necessary condition if the Schroedinger has relevancy to chemistry. Second, once a system is in a particular state with regard to interactions among its components (the assemblage of nuclei and electrons), it cannot spontaneously eliminate any of those interactions. This leads to a subtle form of irreversibility. J.M.S.

N80-25111# IBM Research Lab., San Jose, Calif.
THEORY OF ELECTRONIC, ATOMIC, AND MOLECULAR CALCULATIONS
Robert K. Nesbet Mar. 1980 7 p refs
(Contract N00014-79-C-0406)
(AD-A082891; TR-1) Avail: NTIS HC A02/MF A01 CSCL 09/2

The general approach is to develop computational methods that are quantitative in the sense of being based on the exact formal theory of the processes considered, and are practicable, in the sense of being capable of implementation on digital computers at the present level of technology. For atom-molecule scattering, a new method is being developed that extends a recent theory of the action constants of nonseparable dynamical systems to collision problems. For electron-molecule scattering, a new method for treating vibrational and rotational excitation has been developed, formal theoretical relations needed in detailed applications of this method are being derived, and a new variational approach to quantitative fixed-nuclei calculations is being planned for practical implementation. GRA

N80-25112# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
INTERMOLECULAR ENERGY EXCHANGE BY INFRARED RADIOMETRY Final Report, 1 Jun. - 31 Dec. 1979
J. Fenn, B., S. B. Ryali, and S. P. Venkateshan 31 Jan. 1980 48 p refs
(Contract F49620-79-C-0036; AF Proj. 2303)
(AD-A082540; AFOSR-80-0222TR) Avail: NTIS HC A03/MF A01 CSCL 20/10

Excitation by translational energy of the asymmetric stretch

vibrational mode of ground state carbon dioxide molecules in collision with nitrogen, oxygen and argon molecules has been studied, by intersecting two slightly collimated molecular beams in the field of view of an InSb photovoltaic detector which monitored resulting radiation in the 4.3 micrometer band. The excitation cross sections for all three combinations of partners were of similar magnitude and showed a strong dependence upon collision velocity. For nitrogen the measured cross sections ranged from about 0.0008 square Angstroms at 2 km/s to about 0.5 square Angstroms at 5 km/s. A similar but separate experiment determined an upper limit of 0.1 square Angstroms for the collisional excitation of hydrogen fluoride by krypton at energies up to 1.7 times the threshold requirement. Bulk relaxation rates for molecules in free jet expansion were also investigated. Results obtained from experimental data with the frequently used Sudden Freeze Model have been compared with those obtained by Numerical Integration. Success has been achieved in obtaining Method-of-Characteristics solutions for the free jet expansion with a varying specific heat ratio. This development provides the best description yet of relaxation in free jet expansion for any internal mode which can be characterized by a Boltzmann distribution of energy. GRA

N80-25113# Pennsylvania State Univ., University Park. Applied Research Lab.

SCATTERING OF LOW ENERGY HELIUM BEAMS FROM CLEAN SURFACES OF SODIUM FLUORIDE, LITHIUM FLUORIDE, AND GRAPHITE Ph.D. Thesis

Gregory Neil Derry 13 Dec. 1979 118 p refs

(Contract N00024-79-C-6043)

(AD-A082986; ARL/PSU/TM-79-220) Avail: NTIS HC A06/MF A01 CSCL 07/4

An examination of helium beam scattering from the basal plane of graphite and from (001) surfaces of two alkali halide crystals is presented. Results are given for both (4)He and (3)He. Incident beam energies used range from 2.9 meV to 17.3 meV, chosen to probe the physisorption regime. Bound state energy levels are measured for (4)He and (3)He adsorbed on graphite, NaF and LiF. Matrix elements of the atom-surface potential Fourier components are measured for (4)He on graphite and LiF. A brief discussion of how this information is used to determine the details of the gas-atom - solid surface interaction is given. In the case of (4)He and (3)He on graphite, comparison is made with thermodynamic adsorption data for submonolayer films and excellent agreement is found. Resonance lineshapes are studied for (4)He scattering from LiF and from graphite as the incident angles and energy are varied. The LiF results are seen to agree well with recent theoretical predictions. For graphite, some phenomena exhibit conformance to elastic theory while others appear to contradict it. Experimental evidence that the latter are due to inelastic scattering mechanisms is presented. GRA

N80-25114# Wright State Univ., Dayton, Ohio. Dept. of Chemistry.

COLLISIONAL EXCITATION AND IONIZATION Final Report, 1 Jul. 1975 - 30 Sep. 1979

T. O. Tiernan 30 Sep. 1979 216 p refs

(Contract F44620-76-C-0007; AF Proj. 2303)

(AD-A082884; AFOSR-80-0260TR) Avail: NTIS HC A10/MF A01 CSCL 07/4

Ion-scattering apparatuses were utilized to investigate the kinetics, dynamics and energy transfer characteristics of selected positive and negative ion neutral reactions. Thresholds for endothermic electron transfer reactions involving O3, N2O, CO2, and other atmospheric molecules were determined, and these data were used to determine electron affinities of these species. Similarly, thresholds for collision induced dissociation reactions of O3, CO3, NO3 ions, and other atmospheric negative ions were determined, and ionic bond dissociation energies, heats of formation and electron affinities were derived from these results. GRA

N80-25115# IRT Corp., San Diego, Calif.

MOLECULAR BEAM STUDIES OF LOW ENERGY REACTIONS Final Report, 1 Sep. 1973 - 31 Jan. 1980

R. H. Neynaber and S. Y. Tang 31 Mar. 1980 17 p refs

(Contract N00014-74-C-0011; NR Proj. 012-115; NR Proj. 393-004)

(AD-A082939; IRT-8103-010) Avail: NTIS HC A02/MF A01 CSCL 07/4

A summary of research performed under ONR Contract No. N00014-74-C-0011 is given. The contract covered the period 1 Sept. 1973-31 Jan. 1980. The report describes merging and crossed-beams studies of chemi-ionization and/or ion-molecule reactions. Included are investigations of the Ne(plus) -Ar, Ne(plus) -Kr, Ne(plus) -Xe, He(plus) -D, Ar(plus) -Na, He(plus) -He(plus), He(plus) -Ne(plus), Ar(plus) -Kr(plus), and He(plus) -Ne(plus) systems. GRA

N80-25116# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.

VIBRATIONAL-ROTATIONAL EXCITATION: CHEMICAL VIBRATIONALLY EXCITED MOLECULES

C. Bradley Moore and Ian W. M. Smith (Univ. Chem. Labs., Cambridge, England) Mar. 1979 38 p refs Presented at Faraday Gen. Discussion no. 67 Kinetics of State-Selected Species, Birmingham, England, 9-11 Apr. 1979 Submitted for publication

(Contract W-7405-eng-48)

(LBL-9781; CONF-790411-2) Avail: NTIS HC A03/MF A01

A limited number of systems, particularly gas-phase processes are reviewed. Excited states and their preparation, direct bimolecular reactions, reactions of highly excited molecules, and reactions in condensed phases are discussed. Laser-induced isotope separation applications are mentioned briefly. DOE

N80-25117# California Univ., Berkeley. Lawrence Berkeley Lab.

ALGORITHMS AND COMPUTER CODES FOR ATOMIC AND MOLECULAR QUANTUM SCATTERING THEORY, VOLUME 1

Lowell Thomas, ed. 1979 417 p refs Proceedings of the workshop held at Argonne, Ill., 25-27 Jun. 1979; sponsored by the Natl. Resource for Computation in Chem.

(Contract W-7405-eng-48)

(LBL-9501; CONF-790696) Avail: NTIS HC A18/MF A01

The efficiency of existing computer codes for solving the coupled equations of quantum molecular scattering theory was determined for a variety of test problems. Many of the most active developers and users of these codes discuss the methods and solve a set of test problems using the LBL computers. DOE

N80-25118# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.

MULTIPHOTON PROCESSES IN ISOLATED ATOMS AND MOLECULES Ph.D. Thesis

Assmund Sveinung Sudbo Nov. 1979 132 p refs

(Contract W-7405-eng-48)

(LBL-9796) Avail: NTIS HC A07/MF A01

The theory of coherent excitation of a multilevel quantum mechanical system is developed. Damping of the system is taken into account by the use of a density matrix formalism. General properties of the wave function and/or the density matrix are discussed. The physical implications for the behavior of the system are described, together with possible applications of the formalism, including the infrared multiphoton excitation of molecules, and optical pumping in alkali atoms. Experimental results are presented on the infrared multiphoton dissociation of molecules, followed by a discussion of the general features of this process. The experimental results were obtained using a crossed laser and molecular beam method, and the emphasis is on determining the properties of the dissociating molecule and the dissociation products. The dissociation process is shown to be described very well by the standard statistical theory of unimolecular reactions. DOE

N80-25119# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.

ELECTRON TEMPERATURE DETERMINATION FROM THE He1 3889A AND 5016A LINE INTENSITIES

Nils Brenning Mar. 1979 33 p refs

(TRITA-EPP-79-06) Avail: NTIS HC A03/MF A01

The possibility of determining electron temperature by helium spectroscopy in low density (N sub-e < 10 exp 20/cu m) plasmas is discussed. It is concluded that most lines can only be used at very low densities (N sub e < 2 x 10 exp

16/cu ml) because the line intensities are highly influenced by secondary processes, such as electron impact induced transitions between excited levels or excitations from metastable levels. The density range where measurements are possible can be extended if the influence of these secondary processes on the line intensities can be determined. For most helium 1 lines this is impossible for lack of atomic data. However, there are two exceptions, the 3889A (3 (3)P yields 2(3)S) and the 5016A (3 (1)P yields 2 (1)S) lines. The influence from secondary processes on these lines is calculated, and methods are developed which can be used for measurement of electron temperatures T sub e < 100 eV in plasmas of densities N sub e < 5 x 10 exp 19/cu m. The use of the methods is illustrated by a experiment where they use successfully applied. Author (ESA)

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation*.

N80-25120# SRI International Corp., Arlington, Va.
EMITTANCE OF TRANSPORT OF ELECTRON BEAM IN A FREE ELECTRON LASER
V. Kelvin Neil Dec. 1979 41 p refs
(Contract MDA903-78-C-0086; ARPA Order 2504)
(AD-A081064; SRI-JSR-79-10) Avail: NTIS HC A03/MF A01 CSCL 20/5

In this work we examine the consequences of finite beam emittance and discuss some of the requirements on the beam transport system in a free electron laser; we will not discuss the operation of the FEL. We concentrate on beams from linear accelerators, but the transport theory is quite general and may be applied to beams from (or in) a storage ring. We discuss a fundamental limitation placed on the beam current density by the finite emittance and the resulting spread in axial velocity, continuous solenoidal focusing, and the possibility of focusing the electron beam with the magnetic field of the wiggler. GRA

N80-25121# Los Alamos Scientific Lab., N. Mex.
GENERAL-PURPOSE HEAT SOURCE PROJECT, SPACE NUCLEAR SAFETY PROGRAM, AND RADIOISOTOPIC TERRESTRIAL SAFETY PROGRAM Progress Report
W. J. Maraman, comp. Dec. 1979 37 p
(Contract W-7405-eng-36)
(LA-8184-PR) Avail: NTIS HC A03/MF A01

The formal monthly report covers the studies related to the use of 238PuO2 in radioisotopic power systems carried out for the Advanced Nuclear Systems and Projects Division of the Los Alamos Scientific Laboratory. The three programs involved are: General-Purpose Heat Source Development; Space Nuclear Safety; and Radioisotopic Terrestrial Safety. DOE

N80-25122# Battelle Pacific Northwest Labs., Richland, Wash.
ENVIRONMENTAL CONTROL ASPECTS FOR FABRICATION, REPROCESSING AND WASTE DISPOSAL OF ALTERNATIVE LWR AND LMFBR FUELS
A. M. Nolan, M. A. Lewallen, and G. W. McNair Nov. 1979 94 p refs
(Contract EY-76-C-06-1830)
(BNL-3129) Avail: NTIS HC A05/MF A01

Three different fabrication plants were analyzed using a 50 year dose commitment, a fuel fabrication plant (FFP) to produce low activity uranium and uranium thorium fuel rods, a plutonium fuel refabrication plant (PFRFP) to produce plutonium uranium and plutonium thorium fuel rods, and a uranium refabrication plant (UFRFP) to produce fuel rods containing the high activity isotopes U(-232) and U(-233). Bedded salt was chosen for the waste repository analysis. Wastes assumed to be stored in the repository include high level vitrified waste from the FRP, packaged fuel residue from the FRP, and transuranic contaminated wastes from the FFP, PFRFP, and UFRFP. The potential environmental significance was determined by estimating the ground water concentrations of the various nuclides over a time span of a million years. The maximum permissible concentrations for each nuclide was used along with the estimated ground water concentration to generate a biohazard index for the comparison among fuel compositions. DOE

N80-25123# Los Alamos Scientific Lab., N. Mex.
RESEARCH AND DEVELOPMENT RELATED TO THE NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS Progress Report, 1 Jul. - 30 Sep. 1979
B. M. Crowe, comp. Nov. 1979 14 p refs
(Contract W-7405-eng-36)
(LA-8152-PR) Avail: NTIS HC A02/MF A01

Sorption under anoxic conditions is reported for core samples of tuff from exploratory drill hole UE25a-1. Sorption for Sr, Cs, Ba, Ce, and Eu is somewhat lower in pure nitrogen than in ambient atmosphere, but generally by less than a factor of two. U and Tc sorb poorly in nitrogen; however, an increase over atmospheric conditions is noted for Tc. Final results for sorption of Pu and Am on core samples from drill hole J-13 are presented, and problems with Am are discussed. Ground water composition is found to be a major factor in sorption. Autoradiography indicates that Pu sorbs indiscriminately on rock thin sections and that Np deposits in aggregate form. Zeolite minerals are present within two distinct horizons of tuff. Prototype containment vessels for the hydrothermal soak tests have been assembled and tested. Revised volcanic disruption probability calculations for a 60-km radius circle around Yucca Mountain fall into the range of 10 to the 9th power/year. Petrographic and geochemical data for the basalts of Crater Flat show a strong control of basalt type with structural setting. DOE

N80-25124# Sandia Labs., Albuquerque, N. Mex. Transportation Technology Center.
DEFENSE HIGH-LEVEL WASTE AND SPENT FUEL CHARACTERIZATION FOR GEOLOGIC WASTE REPOSITORIES
S. H. Sutherland and D. E. Bennett Sep. 1979 32 p refs
(Contract EY-76-C-04-0789)
(SAND-79-0172) Avail: NTIS HC A03/MF A01

Results of calculations are given for the total thermal output and radionuclide content, up to 100,000 years decay time, for defense high-level waste expected from three defense industry sites, and for one pressurized water reactor and five boiling water reactor spent fuel types. DOE

N80-25125# Oak Ridge National Lab., Tenn. Energy Div.
PUBLIC INFORMATION ON RADIOACTIVE WASTE: A STUDY OF AN EMERGING ISSUE
L. M. Bronfman, B. H. Bronfman, and J. L. Regens Oct. 1979 59 p refs
(Contract W-7405-eng-26)
(ORNL/OIAPA-13) Avail: NTIS HC A04/MF A01

Through an analysis of information provided in the printed media on the topic of radioactive waste, the emergence of radioactive waste as a public issue in the press is analyzed. Discussions of radioactive waste have focused for all sources more frequently on themes not directly related to the technical problems of radioactive waste storage or isolation. A substantial amount of the information availabe to a variety of segments of the public is composed of discussions of real or perceived risk related to the existence of waste or to methods of disposing of it. In addition to risk, a substantial proportion of the discussions deal with institutional themes. Over time, the total amount of information on most dimensions of the radioactive waste problem has increased substantially. Institutional themes have gained relative to other issues. National and local press sources infrequently specify the form of waste being discussed thus providing evidence that the quality of technical information available to some members of the public is very low. DOE

N80-25128# Oak Ridge National Lab., Tenn.
MANAGEMENT OF RADIOACTIVE WASTES
J. O. Blomeke Nov. 1979 33 p Presented at the Seminar on Nucl. Eng., College Station, Tex., 5-9 Nov. 1979
(Contract W-7405-eng-26)
(DOE/TIC-10294) Avail: NTIS HC A03/MF A01

The nature and characteristics of radioactive wastes and present methods of handling are reviewed. Options available in

waste management and plans and expectations for the future are presented. DOE

N80-25127# Maryland Univ., College Park. Dept. of Physics and Astronomy.
NEW METHODS IN NUCLEAR REACTION THEORY
Edward F. Redish 1979 33 p refs Presented at the Meeting of the Am. Phys. Soc., Washington, D.C., 23-26 Apr. 1979
(Contract EY-76-S-05-5126)
(ORO-5126-97; CONF-790484-4) Avail: NTIS HC A03/MF A01

Standard nuclear reaction methods are limited to treating problems that generalize two body scattering. These are problems with only one continuous (vector) degree of freedom (CDOF). The difficulty in extending these methods to cases with two or more CDOFs is not just the additional numerical complexity, it is hard to guarantee that the proper boundary conditions are satisfied. The physics of this problem in the context of coupled channel calculations is considered. A method for using techniques available for solving problems with two CDOFS in the nuclear N body problem is presented. A set of well posed equations for physical scattering operators is taken, and it is shown how approximation schemes can be developed for a wide range of reaction mechanisms. The resulting general framework for a reaction theory can be applied to a number of nuclear problems. DOE

N80-25128# California Univ., Berkeley. Lawrence Berkeley Lab. Nuclear Science Div.
GAMMA-RAYS FROM DEEP INELASTIC COLLISIONS
F. S. Stephens 1979 43 p refs Presented at the Varonna Conf., Italy, 9-25 Jul. 1979 Submitted for publication
(Contract W-7405-eng-48)
(LBL-10356; CONF-790751-3) Avail: NTIS HC A03/MF A01

The gamma rays associated with deep inelastic collisions can give information about the magnitude and orientation of the angular momentum transferred in these events. Emphasis is placed on understanding the origin and nature of these gamma rays in order to avoid some of the ambiguities that can arise. The experimental information is reviewed, and compared briefly with that obtained by other methods and also with the expectations from current models for deep inelastic collisions. DOE

N80-25129# Brookhaven National Lab., Upton, N. Y.
HYPERNUCLEAR PHYSICS RESEARCH AT BROOKHAVEN
Morgan May 1979 15 p refs Presented at the 1979 Intern. Conf. on Hypernucl. and Low Energy Kaon Phys., Jablonna, Poland, 11-14 Sep. 1979
(Contract EY-76-C-02-0016)
(BNL-27154; CONF-7909118-1) Avail: NTIS HC A02/MF A01

Experiments with the hypernucleus 12/sub lambda/C are described. The observed formation of hypernuclear states at large momentum is compared with theoretical expectations. DOE

N80-25130# Geological Survey, Albuquerque, N. Mex. Water Resources Div.
GEOHYDROLOGY OF THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEAST NEW MEXICO: INTERIM DATA REPORT Final Report
J. W. Mercer and B. R. Orr Jul. 1979 190 p refs Sponsored in part by DOE
(PB80-128782; USGS/WRI-79-98; USGS/WRD/WRI-80/001) Avail: NTIS HC A09/MF A01 CSCL 08H

Hydrologic investigations were conducted to evaluate the feasibility of nuclear-waste storage within bedded salt of the Salado Formation of Permian age. Liquids in the rocks overlying the Salado Formation are found at the contact between the Permian-Rustler and Salado Formations, and in the Culebra and Magenta Dolomite Members of the Rustler Formation. The flow direction and transmissivity range for each formation are discussed. GRA

74 OPTICS

Includes light phenomena.

N80-25131 California Univ., San Diego.
APPLICATION OF INTEGRATED OPTICS TO OPTICAL SIGNAL PROCESSING Ph.D. Thesis
Lew Goldberg 1979 133 p
Avail: Univ. Microfilms Order No. 8009751

Integrated optical logic elements, which carry out digital logic operations between guided light input signals, were developed. Interaction between guided light beams was achieved with LiNbO3 electrooptic modulators, which operated by changing the cut-off condition of the lowest order guided mode in a channel waveguide, and CdS photodetectors. The photodetectors converted one of the input light signals into an electrical current. This current then changed the voltage bias on the electrooptic modulator, thereby changing the transmission state of a second input light signal, and the output of the logic gate. To demonstrate the flexibility of this approach to integrated optical logic, several elementary logic gates were combined on a single LiNbO3 substrate to produce a more complex information processing circuit, that of a half adder. A silicon photodiode for detecting digital signals propagating in optical channel waveguides was developed. The diode configuration was that of one side p-n+ junction formed in a preferentially etched mesa structure. The 7 micron wide mesas were placed in close proximity to the channel waveguide surface. Optical energy was transferred from waveguide to photodiode by evanescent field coupling. Dissert. Abstr.

N80-25132 Arizona Univ., Tucson.
IMAGE PARAMETERS FOR FAST EVALUATION OF ADAPTIVE OPTICAL SYSTEMS Ph.D. Thesis
Noah Bareket 1979 93 p
Avail: Univ. Microfilms Order No. 8009738

A set of image parameters in terms of the first and second moments of the irradiance distribution. The set includes the centroid, variance, eccentricity, and orientation of the principal axes. The relationship between the second moment of the point spread function (PSF) and the optical transfer function (OTF) is established through the moment theorem. The second moment is found to be the sum of a contribution of the pupil amplitude distribution, and a term that is directly related to the wavefront aberrations. One way to measure the image parameters is to sample the PSF by an array of detectors and use the digitized data to circulate the moments of the distribution. Sampling with small elements is shown to be more accurate than sampling with extended elements. An alternate way of measuring the parameters is by means of an analog measurement system based on chopping the images by a series of slits or knife edge apertures. Algorithms for performing the calculation are developed and functional block diagrams of electronic circuitry which perform these calculations are presented. Dissert. Abstr.

N80-25133 Utah Univ., Salt Lake City.
LIGHT SCATTERING BY NONSPHERICAL MULTILAYERED PARTICLES Ph.D. Thesis
Dau-Sing Y. Wang 1979 179 p
Avail: Univ. Microfilms Order No. 8008338

The light scattering characteristics of nonspherical, multilayered objects are theoretically studied using the Extended Boundary Condition Method, a technique capable of accurately evaluating the scattering functions for said objects having random orientations. Scattering calculations made for single layered, prolate spheroids indicate that a significant change in the differential scattering characteristics occurs as the internal structure changes. Angular scattering calculations made for a polydispersion of two layered, prolate, spheroidal particles using a quasi-Gaussian distribution as the density function of the size distribution, indicate changes in the average size of the distribution have a dominant effect on the scattering of such suspensions. Dissert. Abstr.

N80-25134*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PHOTOELECTRIC DETECTION SYSTEM Patent Application

James R. Currie, inventor (to NASA) Filed 30 Apr. 1980 14 p
(NASA-Case-MFS-23776-1; US-Patent-Appl-SN-145272) Avail: NTIS HC A02/MF A01 CSCL 20F

A photoelectric beam system for the detection of the arrival of an object at a discrete station wherein artificial light, natural light, or no light may be present is described. A signal generator turns a signal light on and off at a selected frequency. When the object in question arrives on station ambient light is blocked by the object and the signal light is reflected onto a photoelectric sensor having a delayed electrical output and of the same frequency as the signal light. Outputs from both the signal source and the photoelectric sensor are fed to inputs of an exclusively OR detector which provides as an output the difference between them. The difference signal is a small width pulse occurring at the frequency of the signal source. This signal is distinguished from those responsive to sunlight, darkness, or 120 Hz artificial light by filter means. In this fashion, An object presence is thereby established. NASA

N80-25135# Army Armament Research and Development Command, Dover, N. J. Fire Control and Small Caliber Weapon-System Command
APPLICATION OF THE HAAR TRANSFORM TO IR IMAGERY Final Report
Gary Sivak Mar. 1980 45 p refs
(DA Proj. 121-61101-A-011)
(AD-A082296; AD-E400408; ARSCD-TR-80001) Avail: NTIS HC A03/MF A01 CSCL 09/2

The author's fast Haar transform algorithm, referenced in a previous report, is analytically shown to elicit signal contrast improvement of digital imagery data. The development of a computer program to measure contrast improvement is explained, and tabular and graphical results of contrast increase are presented. A simulation is also developed to explore the algorithm's ability to improve the signal-to-noise ratio of digital imagery, and tabular results of the decrease of the RMS noise levels and increased signal-to-noise ratios are presented. Finally, the algorithm is run using real infrared imagery data, and picture plots before and after Haar processing are shown. GRA

N80-25136# ITT Electro-Optical Products Div., Roanoke, Va.
FIBER OPTIC COUPLERS Final Report, 17 Apr. 1978 - 16 May 1979
G. W. Bickel, Lawrence E. Foltzer, Glen A. Rines, and Art R. Nelson Wright-Patterson AFB, Ohio AFAL Jul. 1979 208 p refs
(Contract F33615-78-C-1448; AF Proj. 2001)
(AD-A082360; AFAL-TR-79-1149) Avail: NTIS HC A10/MF A01 CSCL 20/6

This report is the final report on a one-year technology development program for active and passive fiber optic coupler components. The passive coupler effort consisted primarily of the development of packaging method for coupler type developed previously under contract No. F33615-77-C-1058. The active coupler effort explored techniques of obtaining active switching and modulation for multimode data bus applications. GRA

N80-25137# Hampton Inst., Va. Dept. of Physics.
A STUDY OF TPF STRUCTURE FOR MULTIPLE OVERLAPPING OF PICOSECOND LASER LIGHT PULSES Final Technical Report, Dec. 1978 - Nov. 1979
D. D. Venable 1980 74 p refs
(Grant AF-AFOSR-0036-79; AF Proj. 2301)
(AD-A081939; AFOSR-80-0205TR) Avail: NTIS HC A04/MF A01 CSCL 20/6

A systematic study has been conducted to characterize the multiple overlapping of closely spaced laser pulses in a two photon fluorescence (TPF) cell. Parametric analysis of the autocorrelation function for the amplitude of a closely spaced laser pulse train containing n-pulses has reproduced TPF spectra experimentally observed with a low light level electro-optics detecting system. The effects of one and two photon absorption has been analyzed. Theoretical predictions have been presented for peak to background ratios, number and spacings of TPF peaks, relative TPF peak intensities and fluorescent decay spectra. A design of an experimental system for generating closely spaced laser pulses has been presented. Closed form solutions have been obtained for cases in which two photon absorption is negligible. Finally, it can be concluded that laser pulses separated by distances on the order of one picosecond can be characterized with this system. GRA

N80-25138# Battelle Columbus Labs., Ohio.
OPTICAL WAVEGUIDE SCATTERING REDUCTION Final Report, 15 Apr. 1978 - 15 Apr. 1979
David W. Vahey Wright-Patterson AFB, Ohio AFAL Jun. 1979 76 p refs
(Contract F33615-78-C-1426; AF Proj. 2001)
(AD-A082357; AFAL-TR-79-1113) Avail: NTIS HC A05/MF A01 CSCL 20/6

The goal of this program was the reduction of scattering in optical waveguides to levels commensurate with the required performance characteristics of an integrated optical acoustooptic spectrum analyzer. Waveguides formed by thermal diffusion of Ti films into LiNbO3 substrates were emphasized. The best waveguides were obtained by diffusing thin (+ or - 280 A) Ti films or by polishing waveguides made from thicker films to reduce surface contamination believed to be associated with Li-Ti-O compound formation. Residual scattering in the best waveguides is found to be strongly anisotropic and polarization dependent. Additionally, it can be enhanced by an applied electric field, but not by the photorefractive generation of optical damage using a beam propagating parallel to the optical axis. Possible sources of residual scattering that were considered are antiphase microdomains, separated crystalline phases, and diffused-film imperfections. None of these could be definitely identified as the source of residual scattering in good Ti:LiNbO3 waveguides; however, only the micro-domains hypothesis appears to be ruled out on the basis of its conflicts with various data. Theoretical understanding of the scattering process was extended during the program to account for the two and three dimensional nature of waveguide scatters, and to account for volume as well as surface-roughness scattering centers. GRA

N80-25139# Ampex Corp., Redwood City, Calif. Advanced Technology Div.
OPTICAL CORRELATION STUDIES, CONTINUATION OF LENS PROGRAM Final Report, 1 Jun. 1977 - 28 Apr. 1979
Lawrence R. Weiner Oct. 1979 136 p refs
(Contract N00014-77-C-0447; NR Proj. 366-003)
(AD-A082073; RR-79-23) Avail: NTIS HC A07/MF A01 CSCL 20/6

The present program was provided information that is vital in the determination of the role that optical processing will play in acoustic data gathering systems. The program plan was designed to investigate whether a special purpose optical processor can truly interface with and augment the performance of digital processing equipment. The major accomplishments of this study were: (1) The development of an optical processing algorithm that would accept narrowbanded complex samples and form an ambiguity surface. (2) An optical system was designed and constructed to implement this algorithm. (3) The optical processor was tested by recording simulated acoustic data on film and using these masks as inputs. (4) Experiments were performed on this test bed that provided information on accuracy and detectability of the optical output. (5) Direct comparisons of the optically generated surfaces to surfaces calculated digitally with the same data were made. (6) It was ascertained that these optical techniques would be amenable to real-time implementation if spatial light modulators were substituted for the film. GRA

N80-25140# General Research Corp., Santa Barbara, Calif.
SPIRE: A COMPUTER MODEL OF ELECTRO-OPTICAL SENSORS Final Report, 9 Nov. 1978 - 30 Nov. 1979
H. F. Gilmore 30 Nov. 1979 91 p
(Contract DNA001-78-C-0002; DNA Proj. NWED-QAXHC301)
(AD-A082364; AD-E300694; GRC-RM-2212; DNA-3964F-21) Avail: NTIS HC A05/MF A01 CSCL 17/5

SPIRE (Simulation of Passive Infrared Equipment) is a computer program designed to simulate a variety of electro-optical sensors by representing their various elements. These elements include the optics, the detector array, amplifiers, and other linear and non-linear signal processing stages. This report is a user's

introduction to the program: SPIRE is described, its use is discussed, and examples of applications are given. GRA

N80-25141# Lincoln Lab., Mass. Inst. of Tech., Lexington.
IRAR IMAGE PROCESSING TECHNIQUES
Dorothy R. Sullivan 7 Nov. 1979 45 p refs
(Contract F19628-80-C-0002; AF Proj. 649L)
(AD-A082727; TST-41; ESD-TR-79-271) Avail: NTIS HC A03/MF A01 CSCL 17/9

This report examines the problems associated with the display of active (10.6 micron) infrared radar images. Issues addressed include degradations introduced by the imaging sensor, the effects of these degradations on image tracking and image enhancement, and evaluation of various tracking and enhancement techniques in view of their usefulness and potential hardware implementation. The performance of each algorithm is demonstrated using either simulated data or data collected by the Infrared Airborne Radar (IRAR) testbed system. GRA

N80-25142# Stanford Univ., Calif. Labs. of Physics.
ACOUSTICALLY SCANNED OPTICAL IMAGING DEVICES Semiannual Report, 1 Jul. - 31 Dec. 1979
G. S. Kino, J. Bowers, B. Khuri-Yakub, and R. Thornton Feb. 1980 81 p refs
(Contract N00014-76-C-0129; ARPA Order 2778)
(AD-A082029; SU-GL-3089; SAR-9) Avail: NTIS HC A05/MF A01 CSCL 17/1

Broadband ZnO on Si acoustic surface wave devices with a 40 MHz bandwidth has been demonstrated by making use of a new highly flexible iterative technique for the design of broadband matching networks. The first ZnO on Si Schottky diode correlator has also been demonstrated. Work proceeds on ZnO magnetron sputtering processes, with some problems due to badly oriented gold. These have been cured. GRA

N80-25143# Rockwell International Corp., Anaheim, Calif. Electronic Research Center.
FIBER RING INTERFEROMETER NOISE STUDY Final Technical Report, 1 Aug. 1979 - 31 Jan. 1980
Victor Vali and M. F. Berg 31 Jan. 1980 23 p refs
(Contract N00014-79-C-0675)
(AD-A081935; C80-102/501) Avail: NTIS HC A02/MF A01 CSCL 20/6

All the present fiber ring interferometer gyroscopes are sensitive to changes in environmental conditions. This noise background, which is equivalent to a fringe shift of about ten times the Earth rotation rate, is caused to a large extent by the polarization scrambling in the fiber and by the relative motion of the interferometer components. One of the environmental changes is the variation of the birefringent due to small twists. A way of quantifying this effect on the state of polarization is to introduce controlled twists in a straight, relatively short (about one meter) fiber and determine the output polarization. Another environmental change is the variation of birefringence with temperature changes. An experiment to obtain quantitative results on these effects is described. GRA

N80-25144# Hughes Research Labs., Malibu, Calif.
OPTICAL-MICROWAVE INTERACTIONS IN SEMICONDUCTOR DEVICES Quarterly Report, 1 Oct. - 31 Dec. 1979
L. Figueroa, C. Slayman, and H. W. Yen Feb. 1980 26 p refs
(Contract N00173-78-C-0192)
(AD-A082552; QR-6) Avail: NTIS HC A03/MF A01 CSCL 20/12

GaAs FETs with built-in optical waveguides are being developed. The purpose is to allow optical signals to be coupled into the active region of the devices efficiently. These FETs will be useful for optical mixing, optical injection locking, and optical detection purposes. GRA

N80-25145# Raytheon Co., Waltham, Mass. Research Div.
MANUFACTURING METHODS TECHNOLOGY PROGRAM, ZINC SELENIDE BLANKS FOR WINDOWS AND LENS ELEMENTS Final Technical Report, 17 Jul. 1978 - 17 Nov. 1979
R. N. Donadio, J. F. Connolly, and J. Pappis Feb. 1980 105 p
(Contract DAAB07-78-C-2038)
(AD-A083005; S-2689) Avail: NTIS HC A06/MF A01 CSCL 17/5

This program established a fully automated process for the chemical vapor deposition of zinc selenide blanks. Prior to the program Raytheon Company had an established production process for the fabrication of this material. Further, Raytheon Company had, on an experimental basis, determined that the process could be fully automated by replacing the internally housed zinc source system with an externally housed system that fed zinc into the furnace at a predetermined rate. This system was successfully used in the Pre-Engineering, Engineering, Confirmatory, and Pilot deposits to yield zinc selenide with good optical and mechanical properties. The program also demonstrated that this process significantly reduced the costs of standard type lens blanks. GRA

N80-25146# Stanford Univ., Calif. Physics Labs.
NEW APPROACHES TO OPTICAL SYSTEMS FOR INERTIAL ROTATION SENSING Final Report, 1 Oct. 1978 - 30 Sep. 1979
G. Pavlath, H. J. Shaw, and M. Chodorow 1980 80 p refs
(Grant AF-AFOSR-3070-78; AF Proj. 2305)
(AD-A082533; SU-GL-3094; AFOSR-80-0235TR) Avail: NTIS HC A05/MF A01 CSCL 17/8

The objective of the program is to determine the potential of new fiber optic approaches to inertial rotation sensing. The system presently under investigation is a passive reentrant Sagnac system (PRS) in which light pulses from an external laser, propagating clockwise and counterclockwise around a multiturn sensing loop of single-mode optical fiber, are repetitively recirculated around the multiturn loop a multiplicity of times to increase the sensitivity of the system to inertial rotation. It is shown experimentally that five recirculations around a loop consisting of 600 meters of single mode fiber are possible using bulk optical components of standard precision, with behavior in accordance with theory. This has potential application to small rate-gyros. Work is proceeding on an all-fiber integrated version of the PRS system, which will circumvent serious optical alignment problems encountered with bulk components, and is designed to greatly increase performance as well as reducing size, weight and cost. An optical fiber amplifier being developed under a companion program will be introduced later into this system, to compensate for fiber propagation losses, forming an active reentrant Sagnac system (ARS), designed to permit a very large number of recirculations, forming an integrating-rate-gyro with potential for extreme sensitivity. GRA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N80-25147 Columbia Univ., New York.
THERMONUCLEAR BURN IN WALL-CONFINED PLASMAS Ph.D. Thesis
Lubomyra Nadia Kmetyk 1979 151 p
Avail: Univ. Microfilms Order No. 8008746

The one dimensional initial value problem describing a hot, dense, thermonuclear reacting plasma which is magnetically insulated and contained between cold metal walls has been studied by means of computational simulation. The resulting time evolution of the plasma temperature, number density and magnetic field profiles includes the effects of thermal conduction and radiation energy losses from the plasma, convection, and a detailed treatment of alpha particle heating, as well as ohmic heating and magnetic field diffusion. The results are used to evaluate the net energy gains possible in a shock-heated, magnetically insulated, wall-confined fusion cycle. The energy multiplication is calculated for simple limiting cases and then in greater detail using one dimensional time-dependent physics. The effects on the energy gain of various two dimensional loss mechanisms, such as particle drifts and boundary layer instabilities, are estimated using modified forms of the general one dimensional model. Energy multiplications of between 10 and 20 are calculated

for a cylinder whose mean radius is less than one meter. Energy break-even is found for L = 20 cm, Ein = 1.9 MJ, at a power input of 8.8 TW. Dissert. Abstr.

N80-25148# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ANOMALOUS VISCOSITY IN TURBULENT PLASMA DUE TO ELECTROMAGNETIC INSTABILITY, PART 1
T. Abe and K. Niu (Tokyo Inst. of Tech.) Feb. 1980 27 p refs
(IPPJ-442) Avail: NTIS HC A03/MF A01

The stability of electron plasma with body stress or shear stress is analyzed against the electromagnetic mode. There are two kinds of modes; one is purely transversal, having the electric field perpendicular to the plane of anisotropy, and another is transverse-longitudinal coupled mode, having the electric field in the plane of anisotropy. It is shown that Weibel-type instability occurs in the state where stresses exceed thresholds. Nonlinear theory is used to analyze the stationary turbulence and the viscosity in it. A.R.H.

N80-25149# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ANOMALOUS VISCOSITY IN TURBULENT PLASMA DUE TO ELECTROMAGNETIC INSTABILITY, PART 2
T. Abe and K. Niu (Tokyo Inst. of Tech.) Feb. 1980 19 p refs
(IPPJ-443) Avail: NTIS HC A02/MF A01

It is shown that the electron plasma with stresses (body stress or shear stress) is unstable in the electromagnetic mode (the Weibel type instability) provided that stresses exceed thresholds. The stationary turbulence caused by this instability and the viscosity coefficient in it are analyzed by using the nonlinear theory. The resonance broadening has an important role in the saturation of fluctuations. Author

N80-25150# Nagoya Univ. (Japan). Inst. of Plasma Physics.
REVIEW ON RESONANCE CONE FIELDS
Toshiro Ohnuma (Tohoku Univ., Sendai) Feb. 1980 79 p refs
(IPPJ-446) Avail: NTIS HC A05/MF A01

The resonance cone fields and lower hybrid heating are historically reviewed including experiments and theories. F.O.S.

N80-25151# Nagoya Univ. (Japan). Inst. of Plasma Physics.
NONLINEAR TRANSVERSE VIBRATION OF ELASTIC BEAMS UNDER TENSION
Yoshi H. Ichikawa, Kimiaki Konno (Nihon Univ., Tokyo), and Miki Wadati (Tsukuba Univ., Sakura, Japan) Feb. 1980 10 p refs
(IPPJ-445) Avail: NTIS HC A02/MF A01

Nonlinear transverse vibrations of elastic beams under end-thrust were examined taking full account of the rigorous nonlinear relation of curvature and deformation of elastic beams. When the beams are subject to tension, the derived equation is shown to be reduced to one of the new integrable evolution equations through generalization of the inverse scattering method. Author

N80-25152# Nagoya Univ. (Japan). Inst. of Plasma Physics.
CONTROL OF TOROIDAL EXPANSION OF HIGH BETA PLASMA COLUMN IN PINCH TOKAMAK BY PROGRAMMED PULSED VERTICAL FIELD
A. Nagata, S. Yamaguchi, and K. Hirano Feb. 1980 18 p refs
(IPPJ-444) Avail: NTIS HC A02/MF A01

Dynamics of high beta toroidal pinch plasmas in major radius plane is calculated after simple model and compared with experiments using STP-2 screw pinch under the conditions of T(e) = approximately 20eV and n(e) = approximately 1.2 x 10 to the 15th power cu cm. It is demonstrated that the theory agrees with the experimental results during the early phase of the discharge where the plasma keeps high beta value (poloidal Beta (p) = approximately 3) while discrepancy between the experiment and calculation begins to grow after 8 micron sec from the start of the main discharge because the Beta value decreases considerably. In order not to deviate the plasma column from the center of the discharge tube a concept of effective dissipative force generated by proper programming of the pulsed vertical field is introduced. This concept is shown to be useful in keeping the shock heated high beta plasma in the center of the discharge tube by damping out the unfavorable oscillation in a few oscillation periods. A.R.H.

N80-25153# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
PLASMA HEATING IN CORONAL LOOPS
J. G. Luhmann and R. M. Broussard 15 Feb. 1980 19 p refs
(ATR-80(9552)-1) Avail: NTIS HC A02/MF A01

In the lower corona, where plasma is constrained to flow in the direction of the local magnetic field, a loop field geometry connecting regions of opposite polarity will force plasma originating at the two foot points of the arch-like flux tube to interact. If the tube has a cross section that increases with distance from a foot point, the plasma evaporating at the foot point can be accelerated along the field in the same fashion as the solar wind is accelerated along open diverging flux tubes. If this acceleration occurs symmetrically with respect to the apex of the loop, Coulomb collisions between the ions of the resulting two streams from the opposite foot point convert this direct energy to thermal energy. Since the flux tube converges at both ends and the Coulomb collisions cause pitch angle scattering as well as thermalization, the heated plasma accumulates. The loop is destroyed when the pressure of the trapped plasma becomes greater than the confining pressure. The feasibility of this model of coronal loops is assessed using an example observed with the X-ray telescope on Skylab. A.R.H.

N80-25154# Texas Univ. at Austin. Dept. of Physics.
FORMATION AND DIAGNOSTICS OF A CYLINDRICAL SHELL PLASMA Final Technical Report
Roger D. Bengston, D. L. Honea, and D. Pease 1980 22 p refs
(Grant AF-AFOSR-3258-77; AF Proj. 2301)
(AD-A081983; AFOSR-80-0172TR) Avail: NTIS HC A02/MF A01 CSCL 20/9

An apparatus was developed which forms a hollow cylindrical plasma shell of 3 x 2 cm(2) cross section 40 cm diameter by injecting a neutral gas shell of argon via supersonic injection nozzles and ionizing this shell with a high voltage electrical discharge. GRA

N80-25155# California Univ., Davis. Dept. of Applied Science.
TURBULENT PLASMA HEATING Final Scientific Report, 1 Jul. 1976 - 30 Sep. 1979
John S. DeGroot Sep. 1979 18 p refs
(Contract F49620-76-C-0014; AF Proj. 2301)
(AD-A082228; AFOSR-80-0212TR) Avail: NTIS HC A02/MF A01 CSCL 20/9

This research involved measurements of plasma heating using electron beams, anomalous dc resistivity, and double layers. In addition, the development of a compact X-ray source is being investigated. An extensive set of measurements of the interactions of an electron beam with a collisionless plasma is summarized. It is found that the two stream electron wave decays into a large amplitude ion wave and an electron wave. The ion wave beats with the two stream electron wave and produces a short wavelength electron wave. This beat wave traps and heats the thermal electrons. The efficiency of conversion of beam energy to plasma energy is found to be less than one percent. Steady state anomalous dc resistivity has been investigated in a double plasma device. The spectra of the turbulence and the level of anomalous dc resistivity has been investigated in a double plasma device. The spectra of the turbulence and the level of anomalous dc resistivity are in fair agreement with theory. We have constructed another device which will be used to investigate anomalous dc resistivity at much higher currents and electric fields. We have made preliminary measurements of very large amplitude double layer formation in other experiments. Finally, we are constructing a very high power gas puff z pinch. We will measure the time history of X-ray emission from this device. GRA

N80-25156# California Univ., Livermore. Lawrence Livermore Lab.
RECENT PROGRESS IN INERTIAL CONFINEMENT FUSION AT THE LAWRENCE LIVERMORE LABORATORY

H. G. Ahlstrom and K. R. Manes 15 Oct. 1979 25 p refs Presented at the 11th Ann. Electro Optics/Laser Conf., Anaheim, Calif., 23-25 Oct. 1979 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-83312; CONF-791047-3) Avail: NTIS HC A02/MF A01

The Shiva and Argus laser systems at Livermore were developed to study the physics of inertial confinement fusion. Both laser system designs are predicated on the use of large aperture Nd-glass disk amplifiers and high power spatial filters. During the past year DT-filled microshell targets with and without polymer coatings were irradiated. Recently new instruments were developed to investigate implosion dynamics and to determine the maximum fuel density achieved by these imploded fusion pellets. A series of target irradiations with thin wall microshells at 15 to 20 TW, exploding pusher designs, resulted in a maximum neutron yield of 3 x 10 to the 10th power. Polymer coated microshells designed for high compression were subjected to 4 kJ for 0.2 ns and reached fuel densities of 2.0 to 3.0 gm/cu cm. Results of these and other recent experiments are reviewed. DOE

N80-25157# Los Alamos Scientific Lab., N. Mex.
ULTRA-SOFT X-RAY LIGHT PIPES FOR SPACE-, TIME- AND ENERGY-RESOLVED IMAGING OF HIGH-DENSITY PLASMAS
C. A. Ekdahl Nov. 1979 21 p refs
(Contract W-7405-eng-36)
(LA-8117-MS; Avail: NTIS HC A02/MF A01

By use of the ultra-soft X-ray (USXR) analog of 'light-pipes' space- and time-resolved measurements of plasma radiation in the high-energy region of the emission spectrum can be obtained. Using fast analog-to-digital converters, computerized data acquisition and processing, and the techniques of computer-aided tomography, it is possible to reconstruct from these data the time evolution of a spatially distributed X-ray source. A conceptual design of an apparatus using USXR pipes for obtaining spatially resolved data from the ZT-40 toroidal pinch is described. The pipes also have the property of acting as a dispersing element, and a means of using this feature to obtain information about the spectral properties of the plasma source is described. DOE

N80-25158# California Univ., Livermore. Lawrence Livermore Lab.
NOZZLE MODEL OF FLOWING PLASMA WITH FIELD REVERSAL
J. W. Shearer 7 Jan. 1980 23 p refs
(Contract W-7405-eng-48)
(UCID-18500) Avail: NTIS HC A02/MF A01

The flowing plasma outflow from a field reversed plasma gun is modeled by a one dimensional calculation based on the problem of fluid flow through a nozzle. A low plasma mass flow rate necessary for reconnection to be important. Comparison with 2D MHD calculations and with preliminary data from the BETA-II experiment are consistent with the model at this time. E.D.K.

N80-25159# Department of Energy, Washington, D. C. Office of Energy Technology.
GENERAL CHARACTERISTICS AND ASSESSMENT OF THE SCIENTIFIC/TECHNICAL FEASIBILITY OF THE NEXT MAJOR DEVICE IN THE TOKAMAK FUSION PROGRAM. SUMMARY OF THE US CONTRIBUTIONS TO THE INTOR WORKSHOP
W. M. Stacey, Jr. (Georgia Inst. of Technol., Atlanta), J. R. Gilleland (General Atomic Co., San Diego, Calif.), G. L. Kulcinski (Wisconsin Univ., Madison), and P. H. Rutherford (Princeton Plasma Physics Lab., N.J.) Sep. 1979 18 p Conf. held in Vienna, Austria, Dec. 1979
(DOE/ET-0117/1) Avail: NTIS HC A02/MF A01

A substantial physics and technology data base for INTOR exists today, and this data base will be expanded over the next few years by currently planned programs. However, certain crucial information will not be developed by currently planned programs. Much of this missing information could be developed on the INTOR time scale by the expansion and/or acceleration of existing R and D programs and by the establishment of new R and D programs. On this basis, it is concluded that it is scientifically and technologically feasible to undertake the construction of an INTOR-like device to operate in the early 1990s, provided that the supporting R and D effort is expanded immediately to provide an adequate data base within the next few years in a few critical areas. Furthermore, it is concluded that the construction of an INTOR-like device to operate in the early 1990s is the appropriate next major step in the development of fusion power. DOE

N80-25160# California Univ., Livermore. Lawrence Livermore Lab.
IMPROVED PERFORMANCE OF TANDEM MIRRORS WITH THERMAL BARRIERS
T. B. Kaiser Nov. 1979 21 p refs
(Contract W-7405-eng-48)
(UCID-18308) Avail: NTIS HC A02/MF A01

As originally conceived, tandem mirrors with thermal barriers are limited by MHD instabilities to values of central-cell Beta that are significantly lower than those attainable in tandems without barriers. Much of the degradation in performance is due to the introduction of a new region of unfavorable field line curvature in the central cell. From a variational calculation that maximizes central cell fusion power subject to constraints on the vacuum field energy and allowable interchange instability drive, an analytic expression is derived for a central cell magnetic field strength profile for which the new instability drive is greatly reduced. As a result, central cell performance is enhanced to a point approaching that of tandem mirrors without barriers. Formulas showing how Beta/sub c/ and fusion power scale with design parameters are also derived. DOE

N80-25161# California Univ., Livermore. Lawrence Livermore Lab.
TESTS OF HIGH-POWERED DIRECT CONVERSION ON BEAMS AND PLASMA
W. L. Barr, R. W. Moir, G. W. Hamilton, and A. F. Lietzke (Calif. Univ. Lawrence Berkeley Lab.) 6 Nov. 1979 6 p refs Presented at the 8th Symp. on Eng. Probl. of Fusion Res., San Francisco, 13 Nov. 1979
(Contract W-7405-eng-48)
(UCRL-82852; CONF-791102-31) Avail: NTIS HC A02/MF A01

Two types of direct converters at up to 100 keV were tested. A beam direct converter was tested on a reduced area TFRT source at the Lawrence Berkeley Laboratory (LBL). After surface conditioning and outgassing, the efficiency was over 60% at the beginning of a pulse. During a pulse, the efficiency decreased as the gas density built up. A single-stage plasma direct converter with immersed grids is being tested on a steady-state ion beam with 6 kW of beam power. The power density at the grids can be varied by adjusting the beam focus. Recovery efficiencies over 70% are measured and we are now studying various loss mechanisms. DOE

N80-25162# Science Applications, Inc., Boulder, Colo. Plasma Research Inst.
MODE COUPLING IN A TOROIDAL, SHARP-BOUNDARY PLASMA. 1: WEAK-COUPLING LIMIT
D. A. Dippolito and J. P. Goedbloed (Assoc. Euratom - FOM, Jutphaas, Netherlands) Dec. 1979 37 p refs
(Contracts EY-76-C-03-1018; DE-AC03-79ET-53057)
(SAI-254-79-933-LJ) Avail: NTIS HC A03/MF A01

The phenomenon of mode coupling in the discrete Alfven wave spectrum of ideal magnetohydrodynamics is studied using a simplified plasma model. The occurrence of mode coupling when a periodic modulation of the equilibrium magnetic field strength and curvature is introduced, either by toroidicity or by noncircularity of the cross section is shown. The existence of gaps in the frequency spectrum and the spatial localization of the eigenfunction as a result of mode coupling is analogous to the behavior of valence electrons in a one dimensional crystal lattice. DOE

N80-25163# Kansas State Univ., Manhattan. Dept. of Chemistry.
EXPERIMENTAL INVESTIGATION OF THE CHEMISTRY OF EXCITED STATES OF RARE GASES Quarterly Progress Report, 15 Jan. 1978 - 15 Apr. 1979

D. W. Setser May 1979 8 p refs
(Contract EY-76-S-02-2807)
(COO-2807-17; QPR-2) Avail: NTIS HC A02/MF A01

The reactions of Kr(P-3)1 and Xe(P-3)1 with halogen compounds, producing rare gas halides, were studied. Abstracts of two papers on excited rare gas states are included. DOE

N80-25164# Naval Research Lab., Washington, D. C. Plasma Theory Branch.

TRANSIENT TOKAMAK

W. M. Manheimer and N. K. Winsor 21 Dec. 1979 11 p refs
(Contract EX-76-A-34-1006)
(NRL-MR-4142) Avail: NTIS HC A02/MF A01

The generation of a Tokamak plasma, and its toroidal current, by an intense pulsed ion beam is described. The beam is injected into a target plasma or empty vacuum chamber and then builds the plasma around it. It is shown that ignition is theoretically possible for a dense, high field Tokamak. DOE

N80-25165# Department of Energy, Washington, D. C.

SURVEY OF THERMONUCLEAR INSTABILITIES IN A TOKAMAK

A. B. Mikhaylovskii (Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoj Energii, Moscow, USSR) 1979 24 p refs Transl. into ENGLISH from Russian article
(DOE-TR-218) Avail: NTIS HC A02/MF A01

The results of the linear theory of the cyclotron instability of trapped alpha particles are discussed. The quasi-linear theory of this instability is described. Drift thermonuclear instabilities are then described along with Alfven instabilities caused by the peak on their energy distribution function. The cyclotron Alfven instability is then described. DOE

N80-25166# Naval Research Lab., Washington, D. C. Plasma Physics Div.

SHEAR STABILIZED CYLINDRICALLY SYMMETRIC MIRROR PLASMA Interim Report

W. M. Manheimer 21 Dec. 1979 7 p refs
(Contract EX-76-A-34-1006)
(NRL-MR-4144) Avail: NTIS HC A02/MF A01

A cylindrically symmetric MHD stable mirror plasma is proposed. Shear stabilization is used rather than minimum B. This essentially means running a current through the center of the mirror field. DOE

N80-25167# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research.

MAGNETIC TRAPS WITH A SPHERICAL SEPARATRIX: TORNADO TRAPS

B. P. Paregood (A. F. Ioffe Phys. Tech. Inst.) and B. Lehnert Nov. 1979 92 p refs
(TRITA-EPP-79-18; ISSN-0348-7539) Avail: NTIS HC A05/MF A01

The features of magnetic traps with a spherical separatrix are reviewed with special emphasis on Tornado spiral coil configurations. The confinement and heating of static plasmas in Tornado traps is treated, including the topology of the magnetic field structure, the magnetomechanical properties of the magnetic coil system, and the particle orbits as well as plasma behavior in these traps. In addition, the mode of rotating plasma operation by crossed electric and magnetic fields is described. The results of experiments on static and rotating plasmas are summarised. Conclusions are drawn about future possibilities of Tornado traps for the creation and containment of hot plasmas. Author (ESA)

N80-25168# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research.

A NEUTRON TELESCOPE AND SPECTROMETER FOR DIAGNOSTICS OF EXTENDED FUSION PLASMAS

T. Elevant and B. Holmqvist (Studsvik Sci. Res. Lab.) Sep. 1979 27 p refs Sponsored by EURATOM
(TRITA-PFU-79-09) Avail: NTIS HC A03/MF A01

A method for measurement of the energy spectra of thermonuclear neutrons from a fusion plasma and of the spatial distribution of the emitted neutrons is proposed. It is based on (n,p) scattering in a hydrogeneous specimen. The method provides simultaneous recording of the recoil proton energy and the energy of the corresponding scattered neutron by means of time of flight. Calculations show that an energy resolution less than 2% for D-D plasmas and about 3% for D-T plasmas is feasible. These figures correspond to ion temperatures, which cause a Doppler broadening in the neutron energy, of 0.4 and 7.0 keV, respectively. Results indicate that space resolution of 15 cm can be obtained. Author (ESA)

N80-25169# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research.

ON THE PLASMA BALANCE IN STRAIGHT EXTRAP GEOMETRY

B. Lehnert Oct. 1979 34 p refs
(TRITA-PFU-79-10) Avail: NTIS HC A03/MF A01

The parameter ranges and scaling laws of a small scale straight Extrap experiment were investigated in which a pinched plasma column was stabilized by an imposed inhomogeneous magnetic vacuum field. The relations between the characteristics plasma parameters and their possible ranges of stable and quasisteady equilibrium, as obtained from the results of earlier investigations on the momentum and heat balance, kink stability, and plasma-neutral gas interaction, are discussed. Scaling laws are obtained for the pinch radius, the plasma density, the temperature, and the electrode voltage as functions of the pinch current, the pinch length, and the neutral filling density. From these laws the achievable maximum plasma temperature can be calculated. Additional losses, such as from impurity radiation and Bohm diffusion, modify the scaling as well as the corresponding changes in the resistivity. Author (ESA)

N80-25170# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.

A MULTI-PULSE RUBY LASER RECORDING THE TEMPORAL EVOLUTION OF PLASMA PARAMETERS BY LIGHT SCATTERING

R. Behn 1979 11 p refs Submitted for publication
(IPF-79-4) Avail: NTIS HC A02/MF A01

A ruby laser which delivers about 30 equidistant pulses of MW peak power during each flashlamp discharge is described. The sequence of pulses is obtained by high repetition rate Q-switching with a KD*P Pockels cell. The laser system was developed for scattering diagnostics with the object of recording the temporal evolution of plasma parameters in the sub-millisecond time scale. A scattering experiment using a high current carbon arc plasma as a test object was carried out to demonstrate the capabilities of the system. Results show that for application to a Tokamak plasma a system with higher pulse energies and improved beam divergence is required. For this purpose investigations on oscillator-amplifier operation were carried out. Results demonstrate the validity of this approach. Author (ESA)

N80-25171# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.

WAVE PROPAGATION IN A TEMPERATE n ION SPECIES PLASMA AROUND THE ION CYCLOTRON FREQUENCY RANGE

G. Janzen 1979 27 p refs Submitted for publication
(IPF-79-5) Avail: NTIS HC A03/MF A01

Plane wave propagation in temperate plasmas consisting of n ion species is calculated analytically for collisionless plasmas of arbitrary composition. Numerical results for the complex refractive index of plasmas, including collisions between particles of any kind and at arbitrary angles of propagation, are given. These results show that there are two waves propagating at all angles other than 90 deg, one wave showing resonances at each of the n cyclotron frequencies of the ions involved. High ion-ion collision frequencies combine the motions of the ions to give new mass and composition weighted hybrid ion cyclotron resonances. At right angles to the external magnetic field one wave will propagate in the ion cyclotron range showing n-1 ion-ion-hybrid resonances and n-1 hybrid cutoffs. The ion-ion-hybrid resonances can be traced down to propagation at angles smaller than 90 deg, disappearing for parallel propagation. The hybrid resonance frequencies are close to the cyclotron frequencies of the ions with small relative concentrations. Damping of the waves in the neighborhood of the ion-ion-hybrid resonances is strongly affected by ion-ion collisions. Author (ESA)

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N80-25172 Brown Univ., Providence, R. I.
ONE-DIMENSIONAL SYSTEMS: A NEW VARIATIONAL SOLUTION AND RELATIONS BETWEEN VARIOUS THEORIES Ph.D. Thesis
Ertugrul Berkcan 1978 162 p
Avail: Univ. Microfilms Order No. 8006972

A variational solution of the sine-Gordon theory and the Luther-Emery backward scattering model that is useful for the study of various quasi-one dimensional systems is presented. This yields a renormalized mass for the fundamental fermion of the massive Thirring model and the energy gap in the fermion spectrum of the backward scattering model. The solution is then generalized to a coupled chain problem and related to the SU(2) massive Thirring model. The normalization constants of the Mandelstam's representation for fermion operators are calculated and using the relation of the sine-Gordon theory to the massive thirring model, the renormalized mass of the massive Thirring model and the solitons are obtained in the range where there are no nonleading mass singularities. The one dimensional backward scattering model is related to the sine-Gordon theory by identifying the coupling constants and the cutoff procedures of the two theories. This yields the energy gap in the fermion spectrum for the backward scattering model in the corresponding range. This solution is then formulated in terms of Mandelstam operators. The results obtained are in good agreement with the nonweak coupling methods. Dissert. Abstr.

N80-25173 Georgia Inst. of Tech., Atlanta.
THE SCATTERING OF 5-30 keV HYDROGEN FROM METAL SURFACES Ph.D. Thesis
James Edward Harris 1979 141 p
Avail: Univ. Microfilms Order No. 8010002

The scattering of 5 to 15 keV protons and 30 keV H2(±) from surfaces of Au, Be, C, Cu, Nb, and stainless steel was investigated. Angular distributions of the total and neutral recoil flux were made from 21 degrees up to a 45 degree scattering angle. The flux was found to rise rapidly as the angle increased from the surface, reaching a peak midway between the surface and the specular angle, and declining at larger angles. Energy distributions recorded at a scattering angle theta of 30.4 degrees showed a peak in the intensity between 30% and 80% of the beam's initial energy. Larger angles had peaks at lower energies, and smaller angles showed maxima at larger energies. Numerical integration of the H(±) and H(-) energy distributions gave the ratio of H(-)/H(±). When the projectile's initial energy was reduced, the H(-)/H(±) ratio was found to rise. Absolute measurement of the current of ions scattered from a gold target allowed calibration of other measurements. Large changes in the intensity of the recoil particles and a shift toward lower energies in the energy distributions of scattered ion and in the total recoil flux occurred as the proton dose to the target increased. Dissert. Abstr.

N80-25174*# Guests Associates, Inc., Huntsville, Ala.
GROWTH OF SOLID SOLUTION SEMICONDUCTORS Final Report
Lawrence R. Holland 19 Jan. 1980 32 p refs
(Contract NAS8-33217)
(NASA-CR-161460; Rept-80-TR2) Avail: NTIS HC A03/MF A01 CSCL 20L

Laboratory investigation of tellurium solvent zone growth in which small ampoules were made to determine the rate of floatation separation of excess Te from a molten Hg(0.8)Cd(0.2)Te (1.0) charge is reported including tests performed on the solution grown crystals to determine product uniformity, and the segregation coefficient of HgTe and CdTe for this type of crystal growth. Specific areas covered include the following: (1) tests conducted on the growth of Hg(1-x)CdxTe single crystals by a solvent zone technique; (2) the distillation of ultrapure tellurium and cadmium directly into crystal growth ampoules; (3) Several attempts to grow single crystals in long ampoules by a modified Bridgman-Stockbarger technique, of which two were successful; (4) progress made toward the final definition of a growth ampoule for Bridgman-Stockbarger melt growth in space; and (5) series of tests conducted on fused silica ampoules to determine the safe limits of temperature and internal pressure. J.M.S.

N80-25175# Illinois Univ. at Chicago Circle, Chicago. Dept. of Physics.
STUDY OF THE PHASE TRANSITION IN NIOBIUM DIOXIDE Final Report, 1 Apr. 1977 - 30 Sep. 1979
P. M. Raccah 1 Feb. 1980 21 p refs
(Grant DAAG29-77-G-0084)
(AD-A081575; ARO-14998.3-P; Rept-3-46-32-59-3-60) Avail: NTIS HC A02/MF A01 CSCL 07/2

It is shown that it is indeed possible to use underdamped hard modes of high symmetry to determine quantitatively the temperature dependence of the order parameter in a structural phase transition (SPT). The example chosen is that of the SPT in Niobium dioxide. GRA

N80-25176# Rutgers - The State Univ., Piscataway, N. J. High Pressure Materials Research Lab.
THE POLING TIME DEPENDENCE OF THE FIELD INDUCED PHASE TRANSITION AND THE PIEZOELECTRIC RESPONSE OF POLY(VINYLIDENE FLUORIDE) FILMS
J. I. Scheinbeim, C. H. Yoon, K. D. Pae, and B. A. Newman 1 Mar. 1980 21 p refs Submitted for publication
(Contract N00014-75-C-0540; NR Proj. 356-584)
(AD-A081821; TR-16) Avail: NTIS HC A02/MF A01

The poling time dependence of the field induced phase transition (from phase 2 to polar phase 2) of biaxially oriented poly(vinylidene fluoride) films by X-ray methods have been examined. These results were compared with the poling time dependence of the piezoelectric response (d sub 31 and e sub 31) determined by using a Piezotron Model U (Toyo Seiki, Tokyo). The piezoelectric response shows an initial rapid increase with poling time followed by a slow increase as the poling time increases. The X-ray results show that the field induced phase transition is time dependent, and occurs first for those crystallites with their a axes perpendicular to the film surface. Crystallites with a in the plane of the film transform at a much slower rate. The data indicate that the poling time dependence of d sub 31 and e sub 31 (and, presumably, film polarization) are dependent on the transition rates. GRA

N80-25177# Honeywell, Inc., Minneapolis, Minn. Defense Electronics Div.
EFFECT OF ZrO2 SOURCE VARIATIONS ON PbZrO3-PbTiO3 PIEZOELECTRIC PROPERTIES Final Report, Mar. 1978 - 31 May 1979
W. B. Harrison and M. P. T. Murphy 15 Jan. 1980 51 p refs
(Contract N00014-76-C-0623)
(AD-A082138; HONEYWELL-47602; TR-2) Avail: NTIS HC A04/MF A01 CSCL 11/2

ZrO2, derived from three zircon source minerals and many process variations, was physically and chemically analyzed. The impact of the ZrO2 variations obtained was then evaluated in both dry and wet blended lead zirconate-lead titanate, high drive type piezoelectric compositions. Proper purification and blending of the ZrO2 was shown to yield PZ-PT material with uniform low and high drive piezoelectric behavior. Single precipitated ZrO2 and dry blending were shown to be highly variable processes. Also, solution ceramic approaches produced a higher density PZ-PT. GRA

N80-25178# RCA Labs., Princeton, N. J.
EPITAXIAL GROWTH OF SEMI-INSULATING GaAs Final Report, 1 Jul. 1977 - 31 Aug. 1979
S. T. Jolly, E. C. Douglas, S. G. Liu, C. P. Wu, and C. W. Magee Jan. 1980 101 p refs
(Contract N00014-77-C-0542; DARPA Order 3441)
(AD-A082163; PRRL-80-CR-3) Avail: NTIS HC A06/MF A01 CSCL 07/4

This program was aimed at the study of epitaxial growth of high-resistivity GaAs, high-energy implantation of donors into GaAs, and the use of high-power lasers for annealing implanted

GaAs layers. We have made significant progress in these three areas. We have grown high-resistivity Cr-doped GaAs layers with good surface morphology using both Ga/HCl/AsH3/H2 and Ga/AsCl3/H2 processes. N-layers grown on epitaxial buffer layers have consistently shown lower compensation than direct growth on SI GaAs substrates. Cr doped layers have been grown on both SI GaAs and n or - GaAs substrates. Ion implantation into epitaxial buffer layers, in general, leads to higher electron mobility than direct implantation. GRA

N80-25178# North Carolina State Univ., Raleigh. Engineering Research Services Div.
SINGLE CRYSTAL EPITAXY AND CHARACTERIZATION OF BETA-SILICON CARBIDE Annual Report, 1 Jan. - 31 Dec. 1979
Robert F. Davis 25 Jan. 1980 33 p refs
(Contract N00014-79-C-0121; RR0210203)
(AD-A082036; ATR-243-027-001) Avail: NTIS HC A03/MF A01 CSCL 07/4

The project involves the development of low pressure chemical vapor deposition and r-f sputtering techniques for the synthesis of single crystal thin films of beta-SiC. The CVD apparatus is being produced in-house and a detailed description of the design is provided herein. Theoretical CVD phase diagrams of the Si-C-H system are also being produced as a function of Si/Si-C and total pressure. Both reactive sputtering of Si in CH4 and normal sputtering of a SiC target are being readied. GRA

N80-25180# Rensselaer Polytechnic Inst., Troy, N. Y.
ON THE TEMPERATURE DEPENDENCE OF THE VELOCITY OF SURFACE WAVES IN QUARTZ
B. K. Sinha and H. F. Tiersten Feb. 1980 31 p refs
(Contract N00014-76-C-0368; NR Proj. 318-009)
(AD-A082333; TR-30) Avail: NTIS HC A03/MF A01 CSCL 20/2

The first temperature derivatives of the fundamental elastic constants of quartz are employed along with the thermally-induced biasing strains in the equation for the first perturbation of the eigenvalue for the linear electroelastic equations for small fields superimposed on a bias to calculate the resulting change in surface wave velocity with temperature. Since the description employed is referred to a fixed reference state, the geometry does not change and the temperature coefficient of velocity is the negative of the temperature coefficient of delay. GRA

N80-25181# Rockwell International Corp., Anaheim, Calif. Electronic Devices Div.
EPITAXIAL GARNETS AND HEXAGONAL FERRITES Final Scientific Report, 15 Jan. 1979 - 14 Jan. 1980
Howard L. Glass 28 Feb. 1980 8 p
(Contract F49620-79-C-0048; AF Proj. 2306)
(AD-A082539; C80-149/501) Avail: NTIS HC A02/MF A01 CSCL 07/4

The objective of this research is to develop new and improved epitaxial ferrite materials for use in microwave and millimeter-wave signal processing devices. The major emphasis has been on multiple layer epitaxial garnet structures for magnetostatic wave delay lines. Theoretical analysis was made for magnetostatic surface wave and magnetostatic forward volume wave propagation in structures containing two or three different magnetic garnet layers. Two-layer structures were prepared by liquid phase epitaxy using yttrium iron garnet as a high magnetization layer and lanthanum-gallium substituted yttrium iron garnet as a lower magnetization layer. Measurements of magnetostatic wave propagation at frequencies in the 1 GHz to 6 GHz range were generally in good agreement with the theory. For magnetostatic surface waves, non-dispersive delays of approximately 200 MHz bandwidth at a center frequency of 3 GHz are obtainable. Delay time can be varied from about 50 nsec/cm to 120 nsec/cm by choice of the layer thickness and magnetization. For magnetostatic forward volume waves, it appears to be possible to obtain 1 GHz bandwidths in linearly dispersive delay lines operating at X band. GRA

N80-25182# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Chemistry.
LOW ENERGY ELECTRON DIFFRACTION. LEED-AUGER THIN-LAYER ELECTROCHEMICAL STUDIES OF THE UNDERPOTENTIAL DEPOSITION OF LEAD ONTO GOLD SINGLE CRYSTALS Ph.D. Thesis
Patrick Lee Hagans, A. Homa, W. OGrady, and E. Yeager 15 Dec. 1979 190 p refs
(Contract N00014-75-C-0953)
(AD-A082822; TR-51) Avail: NTIS HC A09/MF A01 CSCL 07/4

The underpotential deposition of lead onto very clean and well-ordered single crystal Au samples was studied with linear sweep voltammetry. The single crystal surfaces examined were (100), (110), (111) and (410). The (410) surface is a stepped surface with terraces of (100) orientation four atomic rows in width separated by steps of (100) orientation of monatomic height. The crystals were prepared in an ultra-high vacuum environment (equivalent to 10 to the minus 11th power Torr) by alternate cycles of argon-ion sputtering and annealing until the surfaces were clean within the limits of AES (Auger Electron Spectroscopy). GRA

N80-25183# Trinity Coll., Dublin (Ireland).
OPTICAL DETECTION OF MAGNETIC RESONANCE IN SEMICONDUCTORS Final Report, Mar. 1979 - Jan. 1980
Brian Henderson Jan. 1980 17 p
(Grant DA-ERO-79-G-0028; DA Proj. 1T1-61102-BH-57)
(AD-A082629) Avail: NTIS HC A02/MF A01 CSCL 20/12

Compound semiconductors were studied using spin sensitive optical polarization and photoconductivity. The spectrometer was redesigned to give greater versatility and sensitivity. Some of the design features were implemented and tested to show that theoretical advantages are indeed matched by experiment. The experiments so far attempted have been concerned with Cd Te and Ga As Cr. For Cd Te, recombination luminescence following band gap excitation is shown to be due to recombination processes involving donor states with g sub D = 1.61 and acceptors of g sub A = 1.35. The spectral dependence of these resonances show that the recombination is complex involving excitons trapped at neutral donors and neutral acceptors as well as holes trapped at neutral donors. The advantage of applying spin sensitive photoconductivity is apparent in experiments using band gap excitation in CdTe. GRA

N80-25184# Pennsylvania State Univ., University Park. Dept. of Chemistry.
SYNTHESIS AND SPECTROSCOPIC CHARACTERIZATION OF H3CoRu3(CO)12 CRYSTAL AND MOLECULAR STRUCTURE OF THE C3v ISOMER Interim Technical Report
W. L. Gladfelter, Gregory L. Geoffroy, and Joseph C. Calabrese 20 Mar. 1980 30 p refs Submitted for publication
(NR Proj. 053-645)
(AD-A082528; TR-6) Avail: NTIS HC A03/MF A01 CSCL 07/4

The reaction of HCoRu3(CO)13 with H2 in refluxing hexane gives the new cluster H3CoRu3(CO)12 in 75% yield. Infrared and H(1) NMR spectra indicate that the cluster exists in two isomeric forms. The structure of one isomer has determined by single crystal X-ray diffraction. The CoRu3 core of the molecule defines a distorted tetrahedron with three carbonyls terminally bound to each metal atom. The hydride ligands were located by difference Fourier techniques and bridge the three Ru-Ru bonds. The overall symmetry of the cluster is approximately C sub 3v. Spectral evidence indicates that the second isomer contains a bridging CO ligand and three non-equivalent hydrogens. The interconversion of the two isomers and the various hydrogen exchange processes have been monitored by H(1) NMR spectroscopy and the exchange mechanisms are discussed. GRA

N80-25185# California Univ., Berkeley. Lawrence Berkeley Lab. Dept. of Physics.
EXPERIMENTAL STUDIES OF EXCITED METALLIC PHASES IN STRESSED GERMANIUM Ph.D. Thesis
J. E. Furneaux Sep. 1979 157 p refs
(Contract W-7405-eng-48)
(LBL-9334) Avail: NTIS HC A08/MF A01

The strain confined electron-hole liquid (SCEHL), a unique form of matter which forms when photoexcited carriers flow into a strain potential well created by suitably inhomogeneously stressing Ge was considered. Various experimental aspects of this SCEHL were studied. DOE

N80-25186# Istituto Superiore di Sanita, Rome (Italy). Lab. delle Radiazioni.
ANALYSIS OF TIN SUPERCONDUCTIVE FILM ELECTROMAGNETIC BEHAVIOR IN A PARALLEL MAGNETIC FIELD [ANALISI DEL COMPORTAMENTO ELETTROMAGNETICO DI FILM SUPERCONDUTTIVI DI STAGNO IN CAMPO MAGNETICO PARALLELO]
M. Flamini, S. Onori, and A. Rogani 20 Jul. 1979 26 p refs In ITALIAN
(ISS-P-79/9; ISSN-0390-6469) Avail: NTIS HC A03/MF A01

The validity of a proposed model for calculating the influence of temperature and thickness of a superconductive film upon the parallel critical magnetic field was experimentally verified for thickness in the order of the coherent length. Tests were made using 15 samples 1000 to 34,000 Angstrom thick. Experimental results are in good agreement with the Landau-Ginzburg model previsions either for thin thick films and the characteristic behavior changes in a continuous way from thin to thick films. The thickness dependence of the penetration depth was determined. Author (ESA)

N80-25187# European Space Agency, Paris (France).
CRYSTAL GROWTH OF 3-5 SEMICONDUCTORS. IMPROVEMENT OF CRYSTAL QUALITY WITH RESPECT TO MICROGRAVITY Final Report
Klaus-Werner Benz, Herbert Weiss (Erlangen-Nurenberg Univ.), and Georg Mueller (Erlangen-Nurenberg Univ.) Nov. 1979 68 p refs Transl. into ENGLISH of "Untersuchung der Moeglichkeiten zur Verbessereng der Kristallqualitaet von 3-5-Halbleitern im Hinblick auf Experimente unter O-g-Bedingungen", Rept. BMFT-FB-W-77-33 BMFT and Erlangen-Nurenberg Univ., Bonn. Original report in GERMAN previously announced as N80-12455
(ESA-TT-577; BMFT-FB-W-77-33) Avail: NTIS HC A04/MF A01

Gallium antimonide (GaSb) and indium antimonide (InSb) crystals were grown by the traveling-solvent-method (TSM) using both a vertical and a horizontal system. The maximum growth rates of GaSb crystals (solution temperature T = 500 C, vertical system) and InSb crystals (solution temperature T = 400 C, horizontal system) were estimated at .003 mm per min and .002 mm per min, respectively. A comparison was made between growth rates calculated by a diffusion limited transport model and the growth rates of the present experiments. It was concluded that the transport mechanism in the solution is governed by convection. The influence of various growth parameters on the crystal quality was studied. GaSb single crystals were grown with a diameter of 10 mm and a length of 30 mm. The dislocation density of these grown crystals was lower by a factor of 100 compared with the dislocation density of the seed crystal. Author (ESA)

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer*.

N80-25188 Texas Univ. at Austin.
THE UNSTABLE STATE AND ITS REPRESENTATION IN QUANTUM DECAY THEORY Ph.D. Thesis
Thomas Keith Bailey 1979 208 p
Avail: Univ. Microfilms Order No. 8009829

The problem of representing unstable quantum states is studied using superoperator quantum theory and complex energy solutions to the Schroedinger equation. The Hamiltonians studied are of the form H = H sub 0 + V, where H sub 0 has a bound state which is unstable with respect to the interaction V. Complex energy poles of the analytically continued resolvent (z - H) to the minus 1st power, are used to determine unstable state solutions to the Schroedinger equation and also the corresponding superoperator eigenvalue problem. The superoperator theory is based on the construction of a Hamiltonian with eigenvector elements as probabilities instead of amplitudes. The most general solution to this analytically continued superoperator eigenvalue problem contains terms which may be associated with the excitation of energy conserving continuous spectrum states. Normalization constants may be chosen so that probability is conserved in the time dependent decay process. Dissert. Abstr.

N80-25189 Stanford Univ., Calif.
QUANTUM THEORY OF COHERENT RAMAN AND COHERENT HYPER-RAMAN SCATTERING Ph.D. Thesis
Jon Orn Bjarnason 1980 156 p
Avail: Univ. Microfilms Order No. 8011605

The fully quantum mechanical theory of coherent Raman scattering in gases and liquids is developed where the electromagnetic radiation is described as a quantized field, and the quantum mechanical transition amplitude for the scattering process is calculated. The Doppler broadened lineshape for the ideal gas is calculated and found to be non-Gaussian with a width that is 1.2 times larger than the Doppler width for spontaneous Raman scattering in the forward direction. The rotational-vibrational bandshape is shown to be related to a correlation function for rotational-vibrational motion. The asymptotic behavior of the coherent Raman signal in the wings of a resonance is found, and the relation between the correlation function and the integrated intensity is derived. The fully quantum mechanical theory of the coherent hyper-Raman effect is treated. The selection rules for coherent hyper-Raman scattering are shown to be identical to those for the spontaneous hyper-Raman process. A relation between the coherent hyper-Raman spectrum and a correlation function of the hyperpolarizability is obtained. The coherent hyper-Raman process bears the same relation to spontaneous hyper-Raman scattering as a coherent Raman process does to spontaneous Raman scattering. Dissert. Abstr.

N80-25190# Arizona Univ., Tucson. Optical Sciences Center.
ELECTROMAGNETIC ANISOTROPY Final Report, 1 Oct. 1976 - 30 Sep. 1979
Peter A. Franken, J. G. Small, and E. Bogatin Dec. 1979 75 p refs
(Contract F49620-77-C-0021; AF Proj. 2301)
(AD-A082232; AFOSR-80-0221TR) Avail: NTIS HC A04/MF A01 CSCL 20/10

Two new precision laser interferometric tests of the postulates of special relativity are described. Two independent frequency stabilized lasers situated on the circumference of a rotatable platform beat together at the center. A variation in the beat frequency as the table rotates can be interpreted as a one way anisotropy in the speed of light. A test for a round trip anisotropy is made by monitoring the cavity length change as the laser orientation change. This can also be interpreted as a mass anisotropy in space. GRA

N80-25191# Texas Univ., Austin. Center for Particle Theory.
FIBER BUNDLES IN A NON-RELATIVISTIC QUANTUM MECHANICS
P. Moylan Nov. 1979 43 p refs
(Contract EY-76-S-05-3992)
(ORO-3992-375) Avail: NTIS HC A03/MF A01

The problem of describing a quantum mechanical system with symmetry by a fiber bundle is considered. The quantization of a fiber bundle is introduced. Fiber bundles for the Kepler problem and the rotator are constructed. The fiber bundle concept provides a model for a physical system: it provides a model for an elementary particle with extension having integral values of spin. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N80-25192 International Institute for Applied Systems Analysis, Laxenburg (Austria).
THE TENNESSEE VALLEY AUTHORITY: A FIELD STUDY
Hans Knop, ed. Jun. 1979 249 p refs
(IIASA-RR-79-2) Avail: Issuing Activity

The results of an international conference on the Tennessee Valley Authority (TVA) are given. They are divided into four main parts: the systems approach to regional industrial development programs; the managerial structure of the TVA, including specific management case studies of several major departments; the application of models and computer techniques to management; and the integration of environmental factors into the TVA management and planning processes, including a case study dealing with the environmental decision-making process in the siting of a nuclear power plant. Author (ESA)

N80-25193*# Perceptronics, Inc., Woodland Hills, Calif.
AN INTERACTIVE COMPUTER AIDING SYSTEM FOR GROUP DECISION MAKING Quarterly Technical Report
Steven Johnston and Randall Steeb May 1979 33 p
(Contract MDA903-77-C-0184; ARPA Order 3344)
(AD-A082440; PQTR-1046-79-5) Avail: NTIS HC A03/MF A01 CSCL 05/1

This report describes progress on work centered on the transfer of an interactive computer aid for group decision making to the DARPA/CTO Demonstration and Development Facility. The report includes: (1) implementation details of both the black and white version and the color version; (2) a description of software support modules required for system integration as a generalized demonstration program at the DDF; (3) the design description of the Group Aid/CACI Executive Aid integration; and (4) a progress report on the full scale experimental studies currently being administered. GRA

N80-25194# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, Va.
AN ALGORITHM FOR COMPUTERIZED ADAPTIVE DECISION ANALYSIS Final Report, Jan. - Sep. 1976
James L. Raney Sep. 1979 43 p refs
(DA Proj. 2T1-61101-A-91B)
(AD-A082924; ARI-TR-406) Avail: NTIS HC A03/MF A01 CSCL 12/1

This research investigated an application of recent results in conjoint measurement theory research with the aim of developing a new methodology for (1) modeling a decision process used to evaluate preferences for complex choice alternatives; and (2) producing measurement scales for choice component factors and composite choice alternatives based on the decision model. An algorithm for interactive conjoint measurement (ICM) was developed to minimize the problems of redundancy and random error in testing the additive-independence model (AIM) in pair-comparisons designs with fallible data. No provisions were made for handling the systematic error problem or for accommodating more than two choice component factors. The ICM algorithm was tested in error-free data and in data with random error. The results showed that this ICM algorithm performed rather poorly. GRA

N80-25195# National Bureau of Standards, Washington, D.C.
DIMENSIONS/NBS, VOLUME 63, NO. 11 Monthly Report
Nov. 1979 41 p refs
(PB80-141542; NBS/DIM-63/11) Avail: NTIS HC A03/MF A02 CSCL 14B

Short summaries of major technical developments, highlights of work in progress, major speeches and statements by Bureau management, and a listing of NBS publications are presented. Topics covered include: fire safety tips for wood burning appliances; computer interface standards; new photometric calibrator performs direct measurement; girth weld standards for Alaskan natural gas pipeline; and 'ultra-black' coating for high absorptance of solar energy. GRA

N80-25196# National Bureau of Standards, Washington, D.C.
DIMENSIONS/NBS, VOLUME 63, NO. 12 Monthly Report
Dec. 1979 37 p refs
(PB80-130701; NBS/DIM-63/12) Avail: NTIS HC A03/MF A01 CSCL 14B

Short summaries of major technical developments, highlights of work in progress, major speeches and statements by Bureau management, and a listing of NBS publications are presented. Topics covered include: protecting citizens' rights; once is enough; guidelines for the use of modernized metric system; refractory concrete strength measured under simulated usage; chemical degradation of refractory liners in coal gasifier systems; data centers established to aid coal conversion industry; conferences; publications; index; and news briefs. GRA

N80-25197# George Washington Univ., Washington, D. C.
THE MEANING OF PATENT STATISTICS Final Report
L. James Harris, Mary A. Holman, Edmund W. Kitch, and Keith Pavitt Dec. 1979 107 p refs Sponsored by NSF Prepared in cooperation with Chicago Univ., Ill., and Sussex Univ., Brighton, England
(PB80-137684; NSF/SIU-79-1) Avail: NTIS HC A06/MF A01 CSCL 05A

The strengths and weaknesses of patent counts as measures of levels of technical invention are discussed. Long range studies providing insight into the meaning of patent data are suggested. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N80-25198*# Herner and Co., Washington, D.C.
AN EVALUATION OF THE GODDARD SPACE FLIGHT CENTER LIBRARY
Saul Herner, F. W. Lancaster, Nancy Wright, Lynn Ockerman, Barbara Shearer, Susan Greenspan, Jule McCartney, and Matthew Vellucci Jul. 1979 68 p refs
(Contract NAS5-25140)
(NASA-CR-159969) Avail: NTIS HC A04/MF A01 CSCL 05B

The character and degree of coincidence between the current and future missions, programs, and projects of the Goddard Space Flight Center and the current and future collection, services, and facilities of its library were determined from structured interviews and discussions with various classes of facility personnel. In addition to the tabulation and interpretation of the data from the structured interview survey, five types of statistical analyses were performed to corroborate (or contradict) the survey results and to produce useful information not readily attainable through survey material. Conclusions reached regarding compatability between needs and holdings, services and buildings, library hours of operation, methods of early detection and anticipation of changing holdings requirements, and the impact of near future programs are presented along with a list of statistics needing collection, organization, and interpretation on a continuing or longitudinal basis. A.R.H.

N80-25199*# General Electric Co., Huntsville, Ala. Space Div.
DATA SYSTEM IMPLICATIONS DERIVED FROM USER APPLICATION REQUIREMENTS FOR SATELLITE DATA
James Neiers May 1979 79 p refs
(Contract NAS8-32491)
(NASA-CR-161468; Doc-79HV005) Avail: NTIS HC A05/MF A01 CSCL 05B

An investigation of the data system needs as driven by users of space acquired Earth observation data is documented. Two major categories of users, operational and research, are identified. Limiting data acquisition alleviates some of the delays in processing thus improving timeliness of the delivered product.

Trade offs occur between timeliness and data distribution costs, and between data storage and reprocessing. The complexity of the data system requirements to apply space data to users' needs is such that no single analysis suffices to design and implement the optimum system. A series of iterations is required with analyses of the salient problems in a general way, followed by a limited implementation of benefit to some users with a continual upgrade in system capacity, functions, and applications served. The resulting most important requirement for the data system is flexibility to accommodate changing requirements as the system is implemented. E.D.K.

N80-25200*# National Aeronautics and Space Administration, Washington, D. C.
A BIBLIOGRAPHY OF SPACE BOOKS AND ARTICLES FROM NON-AEROSPACE JOURNALS, 1957-1977
John J. Looney 1979 258 p
(NASA-TM-81068; HHR-51) Avail: NTIS MF A01; SOD HC CSCL 05B

This bibliography cites over 3,600 articles and books from the nonspecialized secondary literature relating to NASA and to aerospace-related themes. Entries are arranged alphabetically by author in the following categories: (1) space activity; (2) spaceflight: earliest times to the creation of NASA; (3) organization, administration, and management of NASA; (4) aeronautics; (5) boosters and rockets; (6) technology of spaceflight; (7) manned spaceflight; (8) space science; (9) applications; (10) space law; (11) international implications; (12) foreign space programs; (13) domestic public policy and opinion; and (14) economics: impact of NASA, analyses of aerospace industry, and patent policy. A.R.H.

N80-25201# Battelle Pacific Northwest Labs., Richland, Wash.
STATUS OF SORPTION INFORMATION RETRIEVAL SYSTEM
D. D. Hostetler and A. Brandstetter Sep. 1979 64 p
(Contract EY-76-C-06-1830)
(PNL-3139) Avail: NTIS HC A04/MF A01

A sorption information retrieval system designed to provide an efficient, computerized, data base for information on radionuclide sorption in geologic media is described. The dark bank will include Kd values for a large number of radionuclides occurring in radioactive wastes originating from the commercial nuclear power industry. Kd values determined to date span several groundwater compositions and a wide variety of rock types and minerals. The data system will not only include Kd values, but also background information on the experiments themselves. This will allow the potential user to retrieve not only the Kd values of interest but also sufficient information to evaluate the accuracy and usefulness of the data. DOE

N80-25202# California Univ., Berkeley. Electronics Research Lab.
INGRES: A RELATIONAL DATA BASE SYSTEM Final Report, 1 Jun. 1976 - 30 Sep. 1979
M. Stonebraker and E. Wong Sep. 1979 10 p refs
(Grant DAAG29-76-G-0245)
(AD-A082548; ARO-13585.14-EL) Avail: NTIS HC A02/MF A01 CSCL 05/2

The report summarizes the progress made during a three year period on research in data base management. The primary effort has been the design development of a major data base management system of the relational type, INGRES. In addition, a number of new directions, such as distributed data bases and data base machines were initiated. GRA

N80-25203# Department of Energy, Oak Ridge, Tenn. Technical Information Center.
ENERGY INFORMATION DATA BASE, SERIES TITLES: SUPPLEMENT 7, FEBRUARY 1978 - DECEMBER 1979
Dec. 1979 137 p
(DOE/TIC-4579-R10-Suppl-7) Avail: NTIS HC A07/MF A01

Changes and additions to the authority list for serial titles used by the DOE Technical Information Center are listed. Supplements are cumulative from February 1978 until another revision is issued. DOE

N80-25204# Department of Energy, Oak Ridge, Tenn. Technical Information Center.
ENERGY INFORMATION DATA BASE, CORPORATE AUTHOR ENTRIES: SUPPLEMENT 4, JUNE 1978 - DECEMBER 1979
Dec. 1979 57 p
(DOE/TIC-4585-R1-Suppl-4) Avail: NTIS HC A04/MF A01

Additions to the authority list for corporate author names are given. Supplements are cumulative from June 1978 until another revision is issued. DOE

N80-25205# Royal Aircraft Establishment, Farnborough (England).
ACCEPTANCE TESTS FOR THE RAE SCIENTIFIC DATA BASE: THE SCHEMA AND SUBSCHEMA COMPILER TESTS
Irene M. Cummings London HMSO Aug. 1979 27 p refs
(RAE-TM-Math-Comp-7905; BR71363) Avail: NTIS HC A03/MF A01

A data base management system was designed consisting of a set of utility programs and a library of routines which can be incorporated in FORTRAN programs. The system was subjected to a set of rigorous acceptance tests. One set of acceptance tests, prepared for the schema and subschema compilers, are described in detail. These tests are shown to be sufficient to ensure confidence in the soundness of the software.
Author (ESA)

N80-25206# General Electric Co., Arlington, Va.
SHIPPING OPERATIONS INFORMATION SYSTEM: EXECUTIVE OVERVIEW Progress Report, Jun. 1976 - Dec. 1979
Thomas Choate Dec. 1979 63 p
(Contract MA-6-38043)
(PB80-134778; MA-RD-930-80023) Avail: NTIS HC A04/MF A01 CSCL 09B

Computer software modules developed for a shipping operations information system are described. The description of each module includes a functional overview as well as highlights of the capabilities, benefits, and operational elements of the module. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N80-25207# Argonne National Lab., Ill.
MARKET PENETRATION OF NEW ENERGY SYSTEMS ESTIMATED BY ECONOMETRIC AND STOCHASTIC METHODOLOGY
Arvind P. S. Teotia, Chinmei Lee, and Allen S. Kennedy 1979 15 p refs Presented at the IGT Symp. on Energy Modeling 2: The Interface Between Model Builder and Decision Maker, Colorado Springs, Colo., 13-19 Aug. 1979
(Contract W-31-109-eng-38)
(CONF-790852-2) Avail: NTIS HC A02/MF a01

An econometric and stochastic model approach is used to analyze the technical, economic, and market factors influencing the possible market penetration of new energy systems. The market model methodology includes four phases: segment the new technology/end-use market; estimate the technical market; estimate the economic market; and estimate the market penetration. The market penetration of integrated community energy systems (ISCE) is estimated by this methodology. To illustrate the methodology, highlights of the ICES application are included. DOE

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation, and 44 Energy Production and Conversion.*

N80-25208*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ALLEVIATION OF PRESSURE PULSE EFFECTS FOR TRAINS ENTERING TUNNELS. VOLUME 1: SUMMARY Final Report
Bain Dayman, Jr., Andrew G. Hammitt, Harold P. Holway, Curtis E. Tucker, Jr., and Alan E. Vardy Jun. 1979 51 p refs Presented at the 3rd Intern. Symp. on the Aerodyn. and Ventilation of Vehicle Tunnels, Sheffield, England, 12-21 Mar. 1979; sponsored by BHRA Fluid Engineering Sponsored in part by DOT
(Contract NAS7-100)
(NASA-CR-163012; JPL-Pub-78-73-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 13F

The degree to which it is possible to attenuate the effects of pressure pulses on the passengers in trains entering tunnels by modifying the normally abrupt portal of a constant-diameter single track tunnel was investigated. Although the suggested modifications to the tunnel entrance portal may not appreciably decrease the magnitude of the pressure rise, they are very effective in reducing the discomfort to the human ear by substantially decreasing the rate of pressure rise to that which the normal ear can accommodate. Qualitative comparison was made of this portal modification approach with other approaches: decreasing the train speed or sealing the cars. The optimum approach, which is dependent upon the conditions and requirements of each particular rail system, is likely to be the portal modification one for a rapid rail mass transit system. A.R.H.

N80-25209*# Ford Motor Co., Dearborn, Mich. Research Staff.
FEASIBILITY STUDY OF SILICON NITRIDE REGENERATORS
C. A. Fucinari and V. D. N. Rao Oct. 1979 58 p refs
(Contract DEN3-8)
(NASA-CR-159713; DOE/NASA/0008-79/10) Avail: NTIS HC A04/MF A01 CSCL 13F

The feasibility of silicon nitride as a regenerator matrix material for applications requiring inlet temperatures above 1000 C is examined. The present generation oxide ceramics are used as a reference to examine silicon nitride from a material characteristics, manufacturing, thermal stress and aerothermodynamic viewpoint. E.D.K.

N80-25210*# Defense Research Corp., Santa Barbara, Calif. Lunar Systems.
DESIGN AND MANUFACTURE OF WHEELS FOR A DUAL-MODE (MANNED - AUTOMATIC) LUNAR SURFACE ROVING VEHICLE. VOLUME 1: DETAILED TECHNICAL REPORT
May 1970 171 p
(Contract NAS8-25194)
(NASA-CR-163199; TR70-30-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 13F

The concept development, testing, evaluation, and the selection of a final wheel design concept for a dual-mode lunar surface vehicle (DLRV) is detailed. Four wheel configurations were fabricated (one open wheel and three closed wheel) (and subjected to a series of soft soil, mechanical, and endurance tests. Results show that the open wheel has lower draw-bar pull (slope climbing) capability in loose soil due to its higher ground pressure and tendency to dig in at high wheel slip. Endurance tests indicate that a double mesh, fully enclosed wheel can be developed to meet DLRV life requirements. There is, however, a 1.0 to 1.8 lb/wheel weight penalty associated with the wheel enclosure. Also the button cleats used as grousers for the closed-type wheels result in local stress concentration and early fatigue failure of the wire mesh. Load deflection tests indicate that the stiffness of the covered wheel increased by up to 50% after soil bin testing, due to increased friction between the fabric and the wire mesh caused by the sand. No change in stiffness was found for the open wheel. The single woven mesh open wheel design with a chevron tread is recommended for continued development M.G.

N80-25211*# Defense Research Corp., Santa Barbara, Calif.
DESIGN AND MANUFACTURE OF WHEELS FOR A DUAL-MODE (MANNED - AUTOMATIC) LUNAR SURFACE ROVING VEHICLE. VOLUME 2: PROPOSED TEST PLAN
May 1970 40 p
(Contract NAS8-25194)
(NASA-CR-163200; TR70-30-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 13F

A developmental test plan for the wheel and wheel drive assembly of the dual-mode (manned/automated) lunar surface roving vehicle is presented. The tests cover performance, as well as critical environmental characteristics. Insofar as practical, the environmental conditions imposed will be in the sequence expected during the hardware's life from storage through the lunar mission. Test procedures are described for static load deflection and endurance tests. Soft soil tests to determine mobility characteristics including drawbar-pull and thrust vs slip, and motion resistance for various wheel loads are also discussed. Test designs for both ambient and thermal vacuum conditions are described. Facility, transducer, and instrumentation requirements are outlined. M.G.

N80-25212# Ford Motor Co., Dearborn, Mich.
FORD/DOE SODIUM-SULFUR BATTERY ELECTRIC VEHICLE DEVELOPMENT, PHASE 1A Final Report
Dec. 1979 193 p
(Contract EY-76-C-02-2566)
(DOE/CS/2566-1) Avail: NTIS HC A09/MF A01

An evaluation of a NaS battery design, developed for installation in an existing production vehicle, is presented. It is shown that a NaS battery powered two passenger vehicle can have adequate performance and range potential such that its use as a test bed could adequately evaluate the potential of the NaS battery as a power source for further electric vehicles. DOE

N80-25213# Science Applications, Inc., McLean, Va.
ASSESSMENT OF THE TECHNOLOGY TRANSFER POTENTIAL OF FEDERAL PHOTOVOLTAIC POWER SYSTEM APPLICATIONS TO COMMERCIAL MARKETS Final Report
T. F. Jaras, Michael McDonnell, and Richard A. Moyle Jun. 1979 153 p
(Contract EM-78-C-04-4261)
(ALO-4261-TB) Avail: NTIS HC A08/MF A01

An assessment of the market potential of photovoltaic power supplies is presented. Markets analyzed include the water pumping market, marine navigational aids, cathodic protection, remote general power sources, telecommunications, air navigational aids, mobile generator market, instrumentation, and utility connected applications. DOE

N80-25214# Department of Energy, Washington, D. C. Office of Transportation Programs.
ELECTRIC AND HYBRID VEHICLE PROGRAM Annual Report to Congress, FY 1979
Jan. 1980 93 p refs
(DOE/CS-0130; AR-3) Avail: NTIS HC A05/MF A01

The number of vehicles committed to market demonstrations increased from more than 200 in FY 1978 to almost 800 and demonstration sites rose from 16 to 57. There was a modest

increase of commercial interest and public awareness of the potential of electric and hybrid vehicles also was heightened. Market demonstrations, incentives, research and development, product engineering, commercialization activities, and legislative recommendations are reported. DOE

N80-25215# Westinghouse Electric Corp., Pittsburgh, Pa.
RESEARCH, DEVELOPMENT AND DEMONSTRATION OF NICKEL-IRON BATTERIES FOR ELECTRIC VEHICLE PROPULSION Annual Report
Oct. 1979 76 p refs
(Contract W-31-109-eng-38)
(ANL/OEPM-78-14) Avail: NTIS HC A05/MF A01

The fabrication and evaluation of cells are discussed. Electroprecipitation nickel electrodes were prepared of up to 24 Ah/plate (at C/3 drain rate) at design thickness (2.5 mm). Iron electrodes of the composite-type deliver 24 Ah/plate (at C/3) at target thickness (1.0 mm). Both plates display good capacity stability at 130 to 175 test cycles, respectively, in some of the three plate cell tests. Finished cells deliver up to 58 Wh/Kg at C/3, based on projected weight of the finsihed cell and in the actual designed cell volume. Reduction in cell resistance, reduction in nickel plate processing time, and swelling on cycling are areas of major effort to reach the final battery objectives. Thermal nickel electrodes show promise in full size plate tests (up to 22 Ah in a plate of only 2.3 mm thickness). DOE

N80-25216# Volunteers in Technical Assistance, Inc., Mount Rainier, Md.
APPROPRIATE TECHNOLOGY INFORMATION FOR DEVELOPING COUNTRIES. SELECTED ABSTRACTS FROM THE NTIS DATA FILE (SECOND EDITION)
Paul L. Bundick Nov. 1979 413 p Revised Sponsored by NTIS and Agency for International Development
(PB80-117666) Avail: NTIS HC $5.50/MF A01 CSCL 05B

The bibliography is an edited search of 'appropriate technology' citations from the NTIS bibliographic data file. Over 2000 citations with abstracts are included. Appropriate technology was defined, in the context of this publication, as information which can be adapted and applied to improve the quality of life of low-income groups. This does not refer to 'trickle-down' benefits but to direct benefits which foster self-reliance and a sense of dignity among the poor. The information, therefore, is broad in scope covering many fields but pertaining to one or more of the following categories: smaller-scale technologies, labor-intensive technologies, low-cost technologies, revived technologies, improved traditional technologies, alternative techniques, useful social and management technologies and selected modern technologies adapted to the local needs and environment. GRA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N80-25217 Catholic Univ. of America, Washington, D. C.
A SEARCH FOR LONG AND SHORT TERM VARIATIONS IN THE SPECTRUM OF A CENTAURI Ph.D. Thesis
Richard Patrick Fahey 1980 142 p
Avail: Univ. Microfilms Order No. 8011099

Equivalent width and central depth measurements of the ultraviolet absorption lines from the spectrum of the He1 variable star a Cen are presented. The measurements are from short wavelength, and long wavelength, high resolution spectrographs taken with the International Ultraviolet Explorer (IUE) satellite. Central depth measurements were of lines of Cr3, Mn3, V3, C3, Si2, and S2 seen in the region between 1245 and 1255 A. Equivalent widths are of the three He1 2(3)s-n(3) P(0) transitions found at 2945, 2829 and 2764 A. The period for cyclic intensity variations in He1 is determined using a four parameter, least squares fit to a sinusoid. The IUE observations alone match both a period + or - of 8.8163 + or - 0.0003 days and a previously unreported period of 9.2532 + or - 0.0003 days with equal minima for the least squares fit. The phase of C3 maximum relative to He1 maximum is found to be 0.53 cycles for the IUE observations. Dissert. Abstr.

N80-25218 California Inst. of Tech., Pasadena.
THE PHOTOMETRIC PROPERTIES OF BRIGHTEST CLUSTER GALAXIES Ph.D. Thesis
John Greg Hoessel 1980 100 p
Avail: Univ. Microfilms Order No. 8010961

Photometry of a large sample of first ranked cluster galaxies, obtained with SIT and CCD area photometers, is discussed. The absolute photometric results anchor the bright end of the Hubble diagram; essentially the entire formal error for the method is now due to the distant clusters used. Determinations of the systematic trend of galaxy absolute magnitude with the cluster properties of richness and Bautz-Morgan type are derived. All the structure data support and are interpreted on the dynamical friction evolution model. Twenty-eight percent of the galaxies have multiple component nuclei; the short lifetimes of such systems provide the best available evidence that ongoing evolution actually occurs. Average magnitude and structure evolution rates are derived and used to estimate corrections to the value of q sub o derived from the Hubble diagram. When combined with the expected rate of evolution of the stellar population in the galaxies and accounting for known selection effects in the sample, a true value near the formal value of q sub o = -0.5 is indicated, suggesting an open universe. Dissert. Abstr.

N80-25219 Academy of Sciences (USSR), Moscow. Inst. of Space Research.
THEORY OF NP0532 PULSAR RADIATION AND THE NATURE OF CRAB NEBULA ACTIVITY
G. Z. Machabeli and V. V. Usov 1979 44 p refs
(Pr-517) Avail: Issuing Activity

A self-consistent radiation model of the pulsar NP0532 and the Crab Nebula is presented. It is based on the consideration of cyclotron instability in relativistic electron-positron plasma in a strong magnetic field. This instability is found near the light cylinder of pulsar NP0532. The pitch angle and energy distribution of particles, caused by cyclotron instability development are calculated. It is shown that X-ray and gamma ray radiation of the pulsar are explained by the synchrotron radiation of beam particles. Scattering of cyclotron perturbations on plasma particles is responsible for nonzero pitch angles of gamma rays. As a result, the synchroton radiation originates within optical frequencies. As cyclotron waves corresponding to a ratio frequency region can form solitons which carry energy of those waves out of the pulsar magnetosphere, the energy flux due to cyclotron waves from NP0532 is sufficient to explain its radio luminosity. The spectrum of ultrarelativistic electron-positron pairs ejected from the NP0532 pulsar magnetosphere into the Crab Nebula is calculated. Author (ESA)

N80-25220# Astronomisches Inst., Bonn (West Germany).
PUBLICATIONS OF THE ASTRONOMY INSTITUTE OF BONN [VEROEFFENTLICHUNGEN DER ASTRONOMISCHEN INSTITUTE BONN]
1979 54 p refs In GERMAN; ENGLISH summary
Avail: NTIS HC A04/MF A01

Selected topics concerning astronomical photography including use of a double refracting telescope and techniques of hypersensitization of photographic plates are presented. The advantages and capabilities of the PDS 1010A microdensitometer is also discussed. For individual titles, see N80-25221 through N80-25223.

N80-25221# Astronomisches Inst., Bonn (West Germany).
PHOTOGRAPHIC ASTRONOMY AT THE HOHER LIST OBSERVATORY [PHOTOGRAPHISCHE ASTROMETRIE AM OBSERVATORIUM HOHER LIST]
M. Hoffmann and M. Geffert *In its* Publ. of the Astronomy

Inst. of Bonn 1979 p 3-12 refs In GERMAN; ENGLISH summary (For primary document see N80-25220 15-89)
(Rept-89) Avail: NTIS HC A04/MF A01

The operation of the double refractor at the Hoher List Observatory is presented emphasizing the influence of refraction and flexure. The handling of a coordinate measuring engine with an Objective image centering is described. E.D.K.

N80-25222# Astronomisches Inst., Bonn (West Germany).
THE USE OF MICRODENSITOMETER PDS 1010A IN SPECTROSCOPY [DER FINSATZ DES MIKRODENSITOMETERS PDS 1010A IN DER SPEKTROSKOPIE]
H. J. Becker and M. Becker *In its* Publ. of the Astronomy Inst. of Bonn 1979 p 15-40 refs In GERMAN; ENGLISH summary (For primary document see N80-25220 15-89)
(Rept-90) Avail: NTIS HC A04/MF A01

The capabilities of the PDS 1010A microdensitometer, including measurement collection at high speeds and digitalization of such data, are investigated. Results indicate a photometric accuracy of 0.1 to 0.4% at moderate scanning apertures and a positional accuracy of 0.1 micrometers. With these characteristics, spectrograms of standard stars gamma Pegasi and beta Leporis and of the W UMa system AE Phoenicis are reduced. Spectral line curvature, dispersion and characteristic curves, spectrophotometry and radial velocities, are studied. Conventional photometers and oscilloscope setting devices are outperformed in accuracy, objectivity, and speed. E.D.K.

N80-25223# Astronomisches Inst., Bonn (West Germany).
HYPERSENSITIZATION OF PHOTOGRAPHIC PLATES FOR ASTRONOMY PURPOSES [HYPERSENSIBILISIERUNG VON FOTOPLATTEN FUER ASTRONOMISCHE ZWECKE]
J.-D. Schumann *In its* Publ. of the Astronomy Inst. of Bonn 1979 p 43-53 refs In GERMAN; ENGLISH summary (For primary document see N80-25220 15-89)
(Rept-91) Avail: NTIS HC A04/MF A01

The selection of a suitable hypersensitization technique is discussed with emphasis on side effects. Additional fog and its homogeneity, change of gradation, duration of treatment, uniformity of sensitivity, and gain in exposure time, are examined. The selected process works ten times faster than nitrogen soaking and produces less fog than baking or hydrogenization. E.D.K.

N80-25224*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN ASSESSMENT OF GROUND-BASED TECHNIQUES FOR DETECTING OTHER PLANETARY SYSTEMS. VOLUME 2: POSITION PAPERS
David C. Black and William E. Brunk Mar. 1980 253 p refs Prepared in cooperation with NASA, Washington, D.C.
(NASA-CP-2124; A-8114) Avail: NTIS HC A12/MF A01 CSCL 03A

The capabilities of several astronomical interferomenter system concepts are assessed and the effects of the Earth's atmosphere on astrometric precision are examined in detail. Included is an examination of the use of small aperture interferometry to detect planets in binary star systems. It is estimated that, for differential astrometric observation, an amplitude interferometer having two separate telescopes should permit observations of stars as faint as 14th magnitude and a positional accuracy of 0.00005 arc-sec. Instrumental, atmospheric, and photon noise errors that apply to interferometric observation are examined. It is suggested that the effects of atmospheric turbulence may be eliminated with the use of two color refractometer systems. Several sites for future telescopes dedicated to the search for planetary systems are identified. M.G.

N80-25225*# Arizona Univ., Tucson. Optical Sciences Center.
STUDY OF STRAY LIGHT SUPPRESSION FOR THE LARGE SPACE TELESCOPE
B. B. Fannin 5 Mar. 1980 26 p
(Contract NAS8-32127)
(NASA-CR-161455) Avail: NTIS HC A03/MF A01 CSCL 03A

Analysis of light scattering, using the APART computer program, begins at the image plane and progresses through the optical system to the front end of the telescope tube. The approach identifies all critical surfaces, computes the geometrical configuration factors (GCF) from each area of the system under study to all other areas of the system, and determines incident and reflected angles which are important for baffle surfaces which do not have Lambertian scattering characteristics. The power input into the optical surface from either point source objects or extended objects such as the bright Earth are computed. The surface scattering characteristics and the GCF values are combined so that the power transfer to the image plane is computed. Capabilities for handling light scattering from baffle surfaces, specular reflectance from black surfaces, scattering from mirror surfaces, diffraction, internal scattering from transmissive optics, and internal thermal emission are assessed. A.R.H.

N80-25226# Los Alamos Scientific Lab., N. Mex.
GROUND BASED AUTOMATED TELESCOPE
Stirling A. Colgate and William Thompson 1980 12 p refs Presented at the Optical and Infrared Program Conf., Tucson, Ariz., 7-12 Jan. 1980
(Contract W-7405-eng-36)
(LA-UR-80-278; CONF-800116-1) Avail: NTIS HC A02/MF A01

The building of a ground-based automated telescope of the 2 meter class for remote multiuser use as a natural facility is recommended. Experience dictates that a primary consideration is a time shared multitasking operating system with virtual memory overlayed with a real time priority interrupt. The primary user facility is a remote terminal networked to the single computer. The telescope should be rapid slewing, and hence a light weight construction. Automation allows for the closed loop pointing error correction independent of extreme accuracy of the mount. DOE

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N80-25227 Colorado Univ. at Boulder.
ASTROPHYSICAL GAS FLOWS WITH RADIATIVE ENERGY TRANSFER Ph.D. Thesis
Richard A. London 1979 198 p
Avail: Univ. Microfilms Order No. 8011289

Theoretical models for astrophysical shock waves and radiation heated expansion (deflagration-like)waves are presented. The first model described a region which is impulsively heated and accelerated by a shock wave. The gas cools thereafter, primarily by infrared line radiation of H2. The structure of the cooling region is calculated and the values of intial parameters required to match the calculated and observed line strengths are found. The second model is that of an H2 dissociation front caused by UV radiation from a star. The region of dissociation propagates out from a newborn star. The energy balance in the front is controlled by UV absorption and IR emission by the H2 moleculaes. The heating creates a pressure imbalance and a resulting flow. The emission expected from regions is calculated and the gas dynamical effects on the surrounding material are described. The third model is of a stellar atmosphere which is illuminated by X-rays from its compact companion in an X-ray binary system. Dissert. Abstr.

N80-25228 California Inst. of Tech., Pasadena.
INTERACTIONS BETWEEN GALAXIES AND A HOT MEDIUM IN RICH CLUSTERS Ph.D. Thesis
Stephen Matthews Kent 1979 186 p
Avail: Univ. Microfilms Order No. 8010963

The influence of a hot medium on the formation and evolution of galaxies in rich clusters is investigated. The two peculiar systems of emission line filaments around the galaxy NGC1275 in the Perseus cluster are studied. It is concluded that one system consists of condensations in an accretion flow from a surrounding medium onto an underlying elliptical galaxy while the second system arises in a superposed but unrelated spiral galaxy. The formation of SO galaxies by the ram pressure sweeping of spirals due to their motion through a hot intracluster medium is investigated and found to be too weak by a large factor to

produce the required numbers of SO's. Observations of emission lines from spiral galaxies in the X-ray cluster Al367 reveal a deficiency in gas content relative to field galaxies, and is strongest for galaxies closest to the region of X-ray emission. The systematic trends in morphological populations observed in clusters are explained as resulting from a truncation of disks in spirals and SO during their formation due to cluster collapse. Dissert. Abstr.

N80-25229*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CURRENT PROBLEMS IN STELLAR PULSATION INSTABILITIES
David Fischel, Janet Rountree Lesh, and Warren M. Sparks May 1980 687 p refs Conf. held at Greenbelt, Md., 1-2 Jun. 1978
Avail: NTIS HC A99/MF A01 CSCL 03B

Instabilities of pulsating variable stars, such as Cepheid variables, Cepheid masses, early-type variable stars, White Dwarfs, and Mira variables, are discussed. For individual titles, see N80-25230 through N80-25261.

N80-25230*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. Astronomical Inst.
OBSERVATIONS OF CLASSICAL CEPHEIDS
J. W. Pel *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 1-23 refs (For primary document see N80-25229 15-90)
(NASA-TM-80625) Avail: NTIS HC A99/MF A01 CSCL 03B

The observations of classical Cepheids are reviewed. The main progress that has been made is summarized and some of the problems yet to be solved are discussed. The problems include color excesses, calibration of color, duplicity, ultraviolet colors, temperature-color relations, mass discrepancies, and radius determination. R.E.S.

N80-25231*# Los Alamos Scientific Lab., N. Mex. Theoretical Div.
THE PERIODS AND AMPLITUDES OF TU CAS
Stephen W. Hodson and Arthur N. Cox *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 25-40 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

Light curve observations of the double-mode Cepheid TU Cas obtained by 10 different sets of observers on several photometric systems over a time span of 67 years were carefully studied to determine the fundamental and first overtone periods and their amplitudes on the V magnitude scale. The presence of a second overtone radial pulsation is discussed, and it is concluded that a previous detection of this mode was spurious due to the lack of a proper zero point correction for two groups of observations. The amplitudes of the two modes are shown to possibly vary during the entire observing period with the fundamental mode amplitude of 0.69 + or - 0.03 and the overtone amplitude decreasing about 0.2 or 0.3 magnitude. If this Cepheid displays the two pulsation modes because it is mode switching, this switching time scale might be less than a hundred years. R.E.S.

N80-25232*# Nebraska Univ., Lincoln. Behlen Observatory.
THE RADII OF SU CAS AND TU CAS
Gordon D. Niva and Edward G. Schmidt *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 41-54 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

It is possible to obtain the masses of Cepheid variables by several methods involving the pulsation theory. However, these masses are frequently smaller than those indicated by the theory of stellar evolution. The cause of this discrepancy is not fully understood. Since the pulsation theory indicates that there is a relation among the mass, the radius and the period, the discrepancy also manifests itself in the radii of these stars. With this in mind, radius determinations for two Cepheids, SU Cas and TU Cas, were undertaken. It is concluded that because of the agreement between the present radius and the beat radius of TU Cas, the pulsation theory is giving correct information about the radii of beat Cepheids. This implies that the luminosities of short period Cepheids have been overestimated. Thus, the solution to the mass discrepancy should perhaps be sought in the theory of stellar evolution or in the possibility of mass loss. R.E.S.

N80-25233*# Indiana Univ., Bloomington.
ZEEMAN OBSERVATIONS OF W SGR
H. John Wood, W. W. Weiss (University Observatory, Vienna), and H. Jenkner (University Observatory, Vienna) *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 57-67 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

A new precise method for measuring magnetic fields on Zeeman plates of the southern Cepheid 'W Sgr' is reviewed. Ten plates over the 7.6(d) period of pulsation show two extrema in the measured values of the effective magnetic field. The method has a precision of + or - 0.4 microns in the Zeeman shift corresponding to + or - 50 Gauss (g). A negative spike of -220 g occurred at the time of arrival of the compressional wave of pulsation at the stellar surface. A positive field of +270 g occurred at the phase of most rapid contraction near the temperature minimum of the pulsation cycle. R.E.S.

N80-25234*# Los Alamos Scientific Lab., N. Mex. Theoretical Div.
A DISCUSSION OF CEPHEID MASSES
Arthur N. Cox *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 69-95 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

Masses and compositions of Cepheids are essential to map the places in the Hertzsprung-Russell diagram where various radial pulsation modes occur. Luminosity observations and stellar evolution theory give masses for Cepheids which range from 10 percent to a factor of four more than those given by pulsation theory. Combining the evolution and pulsation theories, a theoretical mass was determined using only the period and an approximate surface effective temperature. The ratio of the theoretical to evolutionary masses averaged 0.99 + or - 0.07 for 16 Cepheids. R.E.S.

N80-25235*# New Mexico Univ., Albuquerque. Dept. of Physics and Astronomy.
TRIPLE MODE CEPHEID MASSES
David S. King, Arthur N. Cox, and Stephen W. Hodson *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 97-111 refs Sponsored in part by DOE Prepared in cooperation with LASL (For primary document see N80-25229 15-90)
(Grant NSF AST-76-15445)
Avail: NTIS HC A99/MF A01 CSCL 03B

Unconventional composition structures are proposed to explain the periods of the triple mode Cepheid AC And. A strong Cepheid wind appears to enrich helium in the convection zones down to about 60,000 K or 70,000 K. Then some downward partial mixing occurs to the bottom of a layer with about 1-q = .0005 of the stellar mass. It was found that AC And was not unlike anomalous Cepheids. However, masses of betwen one and two solar masses are suggested and the population is more likely a type two. R.E.S.

N80-25236*# Boston Univ., Mass.
DEPENDENCE OF RED EDGE ON EDDY VISCOSITY MODEL PARAMETERS
Robert G. Deupree and Peter W. Cole *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 113-120 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The dependence of the red edge location on the two fundamental free parameters in the eddy viscosity treatment was extensively studied. It is found that the convective flux is rather insensitive to any reasonable or allowed value of the two free parameters of the treatment. This must be due in part to the fact that the convective flux is determined more by the properties

of the hydrogen ionization region than by differences in convective structure. The changes in the effective temperature of the red edge of the RR Lyrae gap resulting from these parameter variations is quite small (approximately 150 K). This is true both because the parameter variation causes only small changes and because large changes in the convective flux are required to produce any significant change in red edge location. The possible changes found are substantially less than the approximately 600 K required to change the predicted helium abundance mass fraction from 0.3 to 0.2. Author

N80-25237*# Liege Univ. (Belgium). Inst. of Astrophysics.
THERMAL FLICKERS: A SEMIANALYTICAL APPROACH
J. Perdang and J. Robert Buchler *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 121-128 refs Prepared in cooperation with Florida Univ., Gainesville (For primary document see N80-25229 15-90)
(Grants NSF AST-75-05012; NSF AST-77-17572)
Avail: NTIS HC A99/MF A01 CSCL 03B

In order to enhance physical insight into the nature of thermal oscillations arising from a thin helium burning shell, the behavior in its phase plane of a simple two zone model which, however, contains all the relevant physics is analyzed. This simple model very naturally reproduces thermal flickers and is relatively insensitive to all but two parameters. A.R.H.

N80-25238*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
RECENT THEORETICAL WORK ON CEPHEIDS AND OTHER TYPES OF VARIABLES
John P. Cox *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 135-174 refs (For primary document see N80-25229 15-90)
(Grant NSF AST-72-05039)
Avail: NTIS HC A99/MF A01 CSCL 03B

Some important problems in the theory of Cepheids and of other types of variables are pointed out. Three of these are: (1) large-amplitude mode behavior; (2) convection; and (3) Cepheid masses, which must essentially always be inferred indirectly. Of the several types of indirect mass which can be defined, the inferred masses of the 'beat (or double-mode) Cepheids,' seem to be smaller than one expects for this period range by factors of 2-3. For the nonbeat Cepheids, the indirect masses also appear to be low as compared with conventional stellar evolution theory, but by a smaller amount, say some 20-40 percent. Some conceivable ways of explaining these mass discrepancies are discussed. The question of whether the apparently predominantly radial pulsations of the beat Cepheids could be contaminated with a small admixture of nonradial pulsations, so that the use of purely radial pulsation theory may not be applicable to the beat Cepheids is addressed. Some other conjectures which may bear on ordinary or beat Cepheids are offered. A.R.H.

N80-25239*# Los Alamos Scientific Lab., N. Mex.
LIGHT CURVES FOR BUMP CEPHEIDS COMPUTED WITH A DYNAMICALLY ZONED PULSATION CODE
T. F. Adams, J. I. Castor, and C. G. Davis *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 175-186 refs Prepared in cooperation with Joint Inst. for Lab. Astrophysics, Boulder, Colo. (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The dynamically zoned pulsation code developed by Castor, Davis, and Davison was used to recalculate the Goddard model and to calculate three other Cepheid models with the same period (9.8 days). This family of models shows how the bumps and other features of the light and velocity curves change as the mass is varied at constant period. The use of a code that is capable of producing reliable light curves demonstrates that the light and velocity curves for 9.8 day Cepheid models with standard homogeneous compositions do not show bumps like those that are observed unless the mass is significantly lower than the 'evolutionary mass.' The light and velocity curves for the Goddard model presented here are similar to those computed independently by Fischel, Sparks, and Karp. They should be useful as standards for future investigators. A.R.H.

N80-25240*# Rutgers Univ., New Brunswick, N. J. Dept. of Physics and Astronomy.
TIME DOMAIN PERIOD DETERMINATION TECHNIQUES
R. F. Stellingwerf *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 187-198 refs (For primary document see N80-25229 15-90)
(Grant NSF AST-77-26993)
(RU-78-82) Avail: NTIS HC A99/MF A01 CSCL 03B

Two simple period determination schemes are discussed. They are well suited to problems involving non-sinusoidal periodic phenomena sampled at a few irregularly spaced points. Statistical properties are discussed. The techniques are applied to the double mode Cepheids BK Cen and TU Cas as test cases. Author

N80-25241*# Science Applications, Inc., Palo Alto, Calif.
OPTICAL OBSERVABLES IN STARS WITH NON-STATIONARY ATMOSPHERES
R. W. Hillendahl *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 199-236 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

Experience gained by use of Cepheid modeling codes to predict the dimensional and photometric behavior of nuclear fireballs is used as a means of validating various computational techniques used in the Cepheid codes. Predicted results from Cepheid models are compared with observations of the continuum and lines in an effort to demonstrate that the atmospheric phenomena in Cepheids are quite complex but that they can be quantitatively modeled. A.R.H.

N80-25242*# Toronto Univ. (Ontario). Dept. of Astronomy.
MICROTURBULENCE AND WESSELINK RADII
Nancy Remage Evans *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 237-246 refs Sponsored in part by National Research Council of Canada (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

Using the calibration of Bell and Parsons (1974), the effects of changes in microturbulence and surface gravity throughout the cycles of delta Cephei and eta Aquilae are estimated. When the changes in microturbulence are considered, Wesselink radii for these stars are reduced 20%. A.R.H.

N80-25243*# Observatoire de Nice (France).
POPULATION OF THE LOWER PART OF THE INSTABILITY STRIP: DELTA SCUTI STARS AND DWARF CEPHEIDS (OR AI VELORUM)
M. Auvergne, A. Baglin, J. M. LeContel, and J.-C. Valtier *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 247-270 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

Some of the properties of the atmospheric variations in delta Scuti stars were investigated with emphasis on the amplitude and the shape of both light curves and radial velocity curves. It is shown that these curves are small and rapidly variable in the case of dwarf Scuti stars; for the evolved stars the situation is more complex. The relation between variables and nonvariables, and also the results on abundances in the atmospheres of these stars were surveyed with respect to the hydrodynamics of their envelopes. The abundance anomalies of Am stars were qualitatively examined. The coexistence of abundance anomalies and variability among giants were also studied. Attempts were made to relate the variability to the hydrogen ionization zone in an envelope deprived of helium. Specific results are reported. R.C.T.

N80-25244*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE ORIGIN OF PERIOD CHANGES IN RR LYRAE STARS
A. Renzini (Osservatorio Astronomico, Bologna) and A. V. Sweigart *In its* Current Probl. in Stellar Pulsation Instabilities May 1980 p 271-291 refs Submitted for publication (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The observed period changes are explained with respect to the behavior of the semiconductive zone (SCZ) within the core of an RR Lyrae star. General consideration are given which suggest

that the composition changes occurring within the SCZ during the horizontal-branch evolution result; from many small mixing events, each of which slightly perturbs the pulsation period. Results indicate that small mixing events within the core of an RR Lyrae star can produce changes in the pulsation period comparable with those typically observed. It is further indicated that these mixing events together with the nuclear burning between them can produce period changes of both signs. R.C.T.

N80-25245*# Los Alamos Scientific Lab., N. Mex.
THEORETICAL MEAN COLORS FOR RR LYRAE VARIABLES
C. G. Davis and A. N. Cox *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 293-310 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

A hydrodynamically pulsating 0.6 solar mass model of a typical RR Lyrae variable was studied with a radiation transport-hydrodynamic computer program to predict theoretical T sub 3 and colors at many phases and to find the proper methods for getting mean colors and the consequent mean effective temperatures. The variable Eddington radiation approximation method was used with gray and with multifrequency absorption coefficients to represent the radiation flow in the outer optically thin layers. Comparison between observed and computed B-V colors indicate that these low Z population 2 models are reasonably accurate using King 1A composition opacities. The well known Oke, Giver, and Searle relation between B-V and T sub e reproduced. Mean colors were found by four different averaging methods. The method that gives a mean color and the mean T sub e closest to the nonpulsating model was the separate intensity means of B and V. R.C.T.

N80-25246*# Tohoku Univ., Sendai (Japan). Astronomical Inst.
THE EVOLUTIONARY STAGE OF AN RRS STAR SX PHE
Hideyuki Saio and Mine Takeuti *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 317-327 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The evolutionary stage for a short period variable SX Phe was investigated. It was assumed that SX Phe is a mixed star with low metal abundance in which the material was mixed after the star evolved off the main sequence, and is in the second hydrogen burning stage. The validity of this hypothesis was examined by constructing two evolutionary sequences with (X,Z,M/solar mass) = (0.5,0.004,0.75) and (0.5,0.001,0.70) in the hydrogen burning phase and computed the pulsation period. Agreement between theoretical results and observational data was sufficient to conclude that the mixed model is actually adequate for SX Phe. The applicability of this model to other RRs stars is briefly discussed. R.C.T.

N80-25247*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MODE IDENTIFICATION IN BETA CEPHEI STARS
Morris L. Aizenmen and Janet Rountree Lesh *In its* Current Probl. in Stellar Pulsation Instabilities May 1980 p 331-361 refs Prepared in cooperation with NSF, Washington, D.C. (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The essential observational characteristics related to mode identification are summarized. Major emphasis is placed on the following: both light and velocity amplitudes; typical periods in both light and radial velocity; the light curve for Beta Cephei stars in comparison to the classical Cepheids and RR Lyrae stars; the van Hoof effect with respect to the radial velocity curves in many Beta Cephei stars; and the line profiles of many Beta Cephei stars. R.C.T.

N80-25248*# Calgary Univ. (Alberta). Dept. of Physics.
SOME EVOLUTIONARY CONSIDERATIONS OF BETA CEPHEI STARS
S. R. Sreennivasan and W. J. F. Wilson *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 363-380 refs Sponsored in part by National Research Council of Canada (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The evolutionary aspects of massive population 1 stars were investigated. Semiconvection was treated in two different ways, and included mass loss both in the early as well as later spectra stages. The effect of rotation was taken into account and the time evolution of angular momentum of these models was studied. The effect of differential rotation due to the faster rotating interiors and slowed down surface layers are briefly described. R.C.T.

N80-25249*# McDonald Observatory, Austin, Tex.
THE LINE PROFILE VARIABLE B STARS
Myron A. Smith *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 391-407 refs (For primary document see N80-25229 15-90)
(Grants NsG-5167; NSF AST-77-06965)
Avail: NTIS HC A99/MF A01 CSCL 03B

The observational status of the line profile variable B stars is summarized. The following areas are discussed: recent history; evolutionary status; line profile variations; line strength variations; and photometric variations. R.C.T.

N80-25250*# Allegheny Observatory, Pittsburgh, Pa.
PULSATION OF LATE B-TYPE STARS
W. R. Beardsley, T. F. Worek, and M. W. King *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 409-420 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

Radial velocity observations of three of the brightest stars in the Pleiades, Alcyone, Maia and Taygeta, made during the course of one night, 25 October 1976, are discussed. All three stars were discovered to be pulsating with periods of a few hours. Analysis of all published radial velocities for each star, covering more than 70 years and approximately 100,000 cycles, has established the value of the periods to eight decimal places, and demonstrated constancy of the periods. However, amplitudes of the radial velocity variations change over long time intervals, and changes in spectral line intensities are observed in phase with the pulsation. All three stars may also be members of binary systems. M.G.

N80-25251*# McDonald Observatory, Austin, Tex.
THE PULSATING WHITE DWARFS
Edward L. Robinson *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 423-451 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The characteristics of variable white dwarfs are presented through an examination of observational data. The variable white dwarfs are normal, single, DA white dwarfs. The variations are caused by pulsations, but the pulsations are nonradial rather than radial pulsations. The periods are all very long. Excluding harmonics and cross frequencies, the shortest period is 114 sec and the longest period is 1186 sec. Without exception every variable is multiperiodic. The stability of the periods varies from extremely high to very low; the low stability of many of the variables perhaps being due to incomplete data. Finally, there is a strong correlation between the amplitude of the variations and their remaining properties. The higher amplitude variables have more periods in their light curves and the periods are more unstable. M.G.

N80-25252*# Mees (C. E. Kenneth) Observatory, Rochester, N. Y.
THEORIES OF WHITE DWARF OSCILLATIONS
H. M. VanHorn *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 453-500 refs (For primary document see N80-25229 15-90)
(Grant NSF AST-76-80203)
Avail: NTIS HC A99/MF A01 CSCL 03B

The current status of theoretical understanding of the oscillations observed in the ZZ Ceti stars and catachysmic variables is briefly reviewed. Nonradial g-mode oscillations appear to provide a satisfactory explanation for the low amplitude variables such as R548, with periods in the range of approximately 200 to 300 seconds, but for the longer period (800 to 1000 seconds)

oscillators, the situation is still unclear. Rotation may play an important role in this problem, and the effects of both slow and fast rotation upon the mode structure are discussed. In the cataclysmic variables, both accretion and thermonuclear burning may act to excite oscillations of the white dwarf. Author

N80-25253*# McDonald Observatory, Austin, Tex.
THE PERIOD STRUCTURE OF THE ZZ CETI VARIABLES
John T. McGraw *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 501-512 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The current observational status of the period structure of ZZ Ceti stars is reviewed, and in particular those features which appear to be the most important for theory to explain, or which may be relevant to the directions of theoretical development are discussed. Mechanisms to explain the broad range of period structure are suggested. Multiple nonradial modes, probably corresponding to different radial overtones, may be simultaneously excited in each star. The excitation energy of individual stars is distributed among permitted modes by nonlinear resonant coupling. In addition, rotational splitting of the nonradial modes can produce closely spaced periods which results in modulation of the light curve. Amplitude/spectral complexity correlation results from the appearance in the power spectrum of harmonics and cross-frequencies which are the effects brought on by increasing nonlinearity of the pulsations. M.G.

N80-25254*# Pahlavi Univ., Shiraz (Iran). Biruni Observatory.
THE g-MODES OF WHITE DWARFS
Y. Sobouti, M. R. H. Khajehpour, and V. V. Dixit *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 513-531 refs Sponsored in part by Min. of Sci. and Higher Educ. of Iran (For primary document see N80-25229 15-90)
(Contrib-4) Avail: NTIS HC A99/MF A01 CSCL 03B

The neutral g-modes of a degenerate fluid at zero temperature are analyzed. The g-modes of a degenerate fluid at finite but small temperatures are then expanded in terms of those of the zero temperature fluid. For nonrelativistic degenerate fluids it is found that (1) the g-eigenvalues are proportional to T mu(6)sub e mu(-1)sub i, where T is the internal temperature of the fluid, mu sub e and mu sub i are the mean molecular weights of electrons and ions, respectively; (2) the ion pressure is solely responsible for driving the g-modes. For white dwarfs of about a solar mass, the periods of the g-oscillations are in the range of a few hundredths of seconds. Author

N80-25255*# Ohio State Univ., Columbus. Dept. of Astronomy.
MIRA VARIABLES: AN INFORMAL REVIEW
Robert F. Wing *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 533-566 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The structure of the Mira variables is discussed with particular emphasis on the extent of their observable atmospheres, the various methods for measuring the sizes of these atmospheres, and the manner in which the size changes through the cycle. The results obtained by direct, photometric and spectroscopic methods are compared, and the problems of interpretation are addressed. Also, a simple model for the atmospheric structure and motions of Miras based on recent observations of the doubling of infrared molecualr times is described. This model, consisting of two atmospheric layers plus a circumstellar shell, provides a physically plausible picture of the atmosphere which is consistent with the photometrically measured magnitude and temperature variations as well as the spectroscopic data. M.G.

N80-25256*# Washington Univ., Seattle.
VELOCITY STRUCTURE IN LONG PERIOD VARIABLE STAR ATMOSPHERES
C. Pilachowski, G. Wallerstein, and L. A. Willson *In* NASA Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 577-609 refs Sponsored in part by NSF Prepared in cooperation with Iowa State Univ., Ames (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

A regression analysis of the dependence of absorption line velocities on wavelength, line strength, excitation potential, and ionization potential is presented. The method determines the region of formation of the absorption lines for a given data and wavelength region. It is concluded that the scatter which is frequently found in velocity measurements of absorption lines in long period variables is probably the result of a shock of moderate amplitude located in or near the reversing layer and that the frequently observed correlation of velocity with excitation and ionization are a result of the velocity gradients produced by this shock in the atmosphere. A simple interpretation of the signs of the coefficients of the regression analysis is presented in terms of preshock, post shock, or across the shock, together with criteria for evaluating the validity of the fit. The amplitude of the reversing layer shock is estimated from an analysis of a series of plates for four long period variable stars along with the most probable stellar velocity for these stars. J.M.S.

N80-25257*# Mount Stromlo and Siding Spring Observatory, Canberra (Australia).
PULSATION AND MASS LOSS IN MIRA VARIABLES
P. R. Wood *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 611-628 refs (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The behavior of pulsation in the outer layers of a typical Mira variable was studied in the adiabatic and isothermal limits. A shock wave propagates outward once per period and the radial velocity obtained from observations of hydrogen emission lines is identified with the velocity of gas in the post shock region. In the adiabatic case, mass loss in the form of a steady stellar wind was produced. In the isothermal case, no continuous mass loss was produced but occasional ejection of shells occur. Pulsation introduced into a star undergoing steady mass loss as a result of radiation pressure acting on grains caused the mass loss rate to increase by a factor of approximately 40, while the terminal velocity of the flow was almost unaltered. E.D.K.

N80-25258*# Texas Univ. at Austin. Dept. of Astronomy.
AN INDEPENDENT CEPHEID DISTANCE SCALE: CURRENT STATUS
Thomas G. Barnes, III *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 639-646 refs (For primary document see N80-25229 15-90) (Grant NSF AST-76-21316)
Avail: NTIS HC A99/MF A01 CSCL 03B

An independent distance scale for Cepheid variables is discussed. The apparent magnitude and the visual surface brightness, inferred from an appropriate color index, are used to determine the angular diameter variation of the Cepheid. When combined with the linear displacement curve obtained from the integrated radial velocity curve, the distance and linear radius are determined. The attractiveness of the method is its complete independence of all other stellar distance scales, even though a number of practical difficulties currently exist in implementing the technique. E.D.K.

N80-25259*# Delaware Univ., Newark.
THE BARNES-EVANS COLOR-SURFACE BRIGHTNESS RELATION: A PRELIMINARY THEORETICAL INTERPRETATION
Harry L. Shipman *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 647-663 refs (For primary document see N80-25229 15-90) (Grants NsG-5144; NSF AST-76-20723)
Avail: NTIS HC A99/MF A01 CSCL 03B

Model atmosphere calculations are used to assess whethnr an empirically derived relation between V-R and surface brightness is independent of a variety of stellar paramters, including surface gravity. This relationship is used in a variety of applications, including the determination of the distances of Cepheid variables using a method based on the Beade-Wesselink method. It is concluded that the use of a main sequence relation between V-R color and surface brightness in determining radii of giant stars is subject to systematic errors that are smaller than 10% in the determination of a radius or distance for temperature cooler than 12,000 K. The error in white dwarf radii determined

from a main sequence color surface brightness relation is roughly 10%. E.D.K.

N80-25280*# Arizona Univ., Tucson. Dept. of Physics.
EVIDENCE FOR THE EXISTENCE OF NONRADIAL SOLAR OSCILLATIONS: SOLAR ROTATION
Thomas P. Caudell and Henry A. Hill *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 665-675 refs Sponsored in part by NSF and AFGL (For primary document see N80-25229 15-90)
Avail: NTIS HC A99/MF A01 CSCL 03B

The coherent properties of six oscillations over a two week period in which seven days of equatorial diameter measurements were analyzed, are confirmed by the addition of an extra day of data. The two large 1 (the principal order number in the spherical harmonic expansion of the eigenfunction) g-mode oscillations may be candidates for the slowly rotating mode locked structures. For the four low frequency p-modes, periodic nature is observed in the daily power levels, varying with periods of several days. This is attributed to beating between rotationally split m states for a given 1 value. Nonradial modes are a major contribution to the observed solar oscillations. The nonradial character of the observed modes allows the depth dependence of the internal solar rotation to be investigated. E.D.K.

N80-25281*# Lick Observatory, Santa Cruz, Calif.
A PRELIMINARY ATTEMPT TO INTERPRET THE POWER SPECTRUM OF THE SOLAR FIVE MINUTE OSCILLATIONS IN TERMS OF THE GLOBAL OSCILLATION MODEL
D. A. Kesley *In* NASA. Goddard Space Flight Center Current Probl. in Stellar Pulsation Instabilities May 1980 p 677-694 refs (For primary document see N80-25229 15-90)
(Grant NGL-05-002-003)
Avail: NTIS HC A99/MF A01 CSCL 03B

The observed power spectrum of the solar five minute oscillations is discussed from the viewpoint that the oscillations are excited by turbulent convection. The observations place significant constraints on the theory and suggest constraints on the solar model structure. It is shown that the steep low frequency side of the peak in the power spectrum is more readily explained if the mixing length is greater than one scale height. The high frequency end of the power spectrum is also discussed. J.M.S.

N80-24702*# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
REQUIREMENTS FOR PREDICTIONS AND REAL-TIME MONITORING FOR THE STUDY OF TRAVELLING INTERPLANETARY PHENOMENA
Murray Dryer and M. A. Shea (AFGL, Hanscom AFB, Mass.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 340-345 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology: and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

No abstracts in this category.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N80-25282*# Denver Univ., Colo. Dept. of Physics.
ANALYSIS OF SOLAR SPECTRA IN THE MIDDLE ULTRAVIOLET AND VISIBLE FOR ATMOSPHERIC TRACE CONSTITUENTS MEASUREMENTS Final Report, 15 Mar. 1977 - 15 May 1980
A. Goldman 20 May 1980 54 p refs
(Grant NsG-1405)
(NASA-CR-163150) Avail: NTIS HC A04/MF A01 CSCL 03B

Individual spectral line parameters including line positions, strengths, and intensities were generated for the sq Alpha Sigma - sq Chi Pi (0,0) band of OH, applicable to atmospheric and high temperatures. Energy levels and transition frequencies are calculated by numerically diagonalizing the Hamiltonian. Line strengths are calculated using the dipole matrix and eigenvectors derived from energy matrix diagonalization. The line strengths are compared to those calculated from previously published algebraic line strength formulas. Tables of line parameters are presented for 240 K and 4600 K. Author

N80-25283*# Atmospheric and Environmental Research, Inc., Cambridge, Mass.
A STUDY OF ACOUSTIC HEATING AND FORCED CONVECTION IN THE SOLAR CORONA Final Report, 1 Jan. 1979 - 1 Apr. 1980
Peter V. Foukal 11 Apr. 1980 51 p refs
(Contract NAS8-32985)
(NASA-CR-161454) Avail: NTIS HC A04/MF A01 CSCL 03B

The S055 EUV spectra was used to perform emission measure and line intensity ratio analyses of loop plasma conditions in a study on the thermodynamics of magnetic loops in the solar corona. The evidence that loops contain plasma hotter than the background corona, and thus, require enhanced local dissipation of magnetic or mechanical energy is discussed. The S055 EUV raster pictures were used to study physical conditions in cool ultraviolet absorbing clouds in the solar corona, and optical data were used to derive constraints on the dimension, time scales and optical depths in dark opaque clouds not seen in H alpha and CaK as filaments or prominences. Theoretical modelling of propagation of magnetically guided acoustic shocks in the solar chromosphere finds it still unlikely that high frequency acoustic shocks could reach the solar corona. Dynamic modelling of spicules shows that such guided slow mode shocks can explain the acceleration of cool spicular material seen high in the corona. E.D.K.

N80-25284*# Alabama Univ. in Huntsville.
DYNAMIC SIMULATION OF CORONAL MASS EJECTIONS Final Report
R. S. Steinolfson and S. T. Wu Apr. 1980 141 p refs
(Contract NAS8-33216)
(NASA-CR-161461; UAH-RR-240) Avail: NTIS HC A07/MF A01 CSCL 03B

A model is developed for the formation and propagation through the lower corona of the loop-like coronal transients in which mass is ejected from near the solar surface to the outer corona. It is assumed that the initial state for the transient is a coronal streamer. The initial state for the streamer is a polytropic, hydrodynamic solution to the steady-state radial equation of motion coupled with a force-free dipole magnetic field. The numerical solution of the complete time-dependent equations then gradually approaches a stationary coronal streamer configuration. The streamer configuration becomes the initial state for the coronal transient. The streamer and transient simulations are performed completely independent of each other. The transient is created by a sudden increase in the pressure at the base of the closed-field region in the streamer configuration. Both coronal streamers and coronal transients are calculated for values of the plasma beta (the ratio of thermal to magnetic pressure) varying from 0.1 to 100. M.G.

N80-25285# California Univ., Berkeley. Lawrence Berkeley Lab.
MEASUREMENT AND ANALYSIS OF CIRCUMSOLAR RADIATION Summary Report, Apr. - Sep. 1979
D. F. Grether, D. Evans, A. Hunt, and M. Wahlig Oct. 1979

11 p refs Presented at the DOE Div. of Distributed Solar Technol. Insulation Assessment Contractor's Program Rev., Bethesda, Md., 31 Oct. - 1 Nov. 1979
(Contract W-7405-eng-48)
(LBL-10243) Avail: NTIS HC A02/MF A01

Four instrument systems called Circumsolar Telescopes, used to measure the solar and circumsolar radiation for application to solar energy systems, employ lenses or mirrors to concentrate the incident sunlight. Each measuring system has a scanning telescope mounted on a precision solar tracker. The telescope is mechanically scanned thru an arc of 6 deg with the sun at the center of the arc. A digitization of the brightness of the sun or circumsolar radiation is taken every 1.5 min. of arc, with a complete scan taking one minute of time. Auxiliary instruments include a pyroheliometer and two pyranometers, one mounted in the usual horizontal position and one tracking the sun. The telescope and pyroheliometer have batched ten position filter wheels: one open position, eight interference filters that divide the solar spectrum into eight intervals of roughly equal energy content, and one opaque filter to monitor detector noise. The data are recorded on magnetic tape, with one tape holding one week's worth of data per telescope. DOE

N80-25266# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
ENERGY SOURCE OF THE SOLAR WIND
P. Carlqvist and H. Alfven Oct. 1979 14 p refs
(TRITA-EPP-79-17; ISSN-0348-7539) Avail: NTIS HC A02/MF A01

A direct transfer of energy from photospheric activity to the solar wind by means of electric currents is discussed. Currents are assumed to flow in quiescent prominences which occasionally erupt and give rise to expanding looplike structures in the corona as observed from Skylab. Due to the expansion the legs of the loops are transformed into coronal rays which carry currents from the photosphere to the outer parts of the corona or interplanetary medium and then back again to the photosphere. It is proposed that energy is transferred from photospheric activity to the solar wind (1) as kinetic energy of the ejected loop matter; (2) as electric power directly fed into the extended loops; and (3) as torsional waves produced by fluctuations in the loop currents. Author (ESA)

N80-25267# National Center for Atmospheric Research, Boulder, Colo.
SUNSPOT VECTOR MAGNETIC FIELDS AND MODEL UMBRAL ATMOSPHERES. Final Report
Joseph Beurak Gurman Sep. 1979 205 p refs
(Grant NSF ATM-77-23757)
(PB80-135247; NCAR-CT-55) Avail: NTIS HC A10/MF A01 CSCL 03B

The Stokes polarimeter of the High Altitude Observatory was used to observe a round, unipolar sunspot in three absorption lines and the nearby continua. Observations in the weak Zeeman triplet at 6302.50A wavelength are used to derive the vector magnetic field across the spot. Stokes profiles are used to probe the depth variation of the magnetic field and to obtain a model atmosphere for the umbra. A linear anticorrelation is found between the continuum intensity and the magnetic field strength. Model atmospheres determined at four locations in the umbra represent a significant improvement over the few existing umbral models in fitting the observed D2 line wings. A method of determining the longitudinal component of the B field as a function of depth is derived and tested with synthetic Stokes profiles. GRA

N80-24692*# Space Environment Services Center, Boulder, Colo.
VERY LARGE GEOMAGNETIC DISTURBANCE DURING SUNSPOT CYCLE 21: A PREDICTION
H. H. Sargent, III *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 193-197 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

N80-24696*# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
LONG-TERM SOLAR ACTIVITY PREDICTIONS
P. S. McIntosh, G. M. Brown, R. Buhmann, T. Clark, P. F. Fougere, H. Hunter, J. V. Lincoln, H. H. Sargent, III, J. G. Timothy, and Y. Z. Lin *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 246-257 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

N80-24697*# Main Astronomical Observatory, Pulkovo (USSR).
A NEW METHOD OF VERY LONG-TERM PREDICTION OF SOLAR ACTIVITY
A. I. Ohl and G. I. Ohl (Arkticheskii i Antarkticheskii Nauchno-Issled. Inst.) *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 258-263 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

N80-24698*# University Coll. of Wales, Aberystwyth. Dept. of Physics.
NEW METHODS FOR PREDICTING THE MAGNITUDE OF SUNSPOT MAXIMUM
G. M. Brown *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 264-279 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

N80-24699*# Colorado Univ., Boulder. Atmospheric and Space Physics Lab.
THE VARIABILITY OF THE SOLAR ULTRAVIOLET SPECTRAL IRRADIANCES
J. Gethyn Timothy *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 280-321 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

N80-24700*# Astronomical Inst., Utrecht (Netherlands). Space Research Lab.
THE NEEDS FOR PREDICTION AND REAL-TIME MONITORING FOR THE FLARE BUILD-UP STUDY
Zdenek Svestka *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 322-330 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

N80-24701*# American Science and Engineering, Inc., Cambridge, Mass.
SOLAR FORECAST AND REAL-TIME MONITORING NEEDS OF THE STUDY OF ENERGY RELEASE IN FLARES (SERF)
David M. Rust *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 331-339 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

N80-24703*# National Aeronautics and Space Administration, Washington, D. C.
SOLAR WIND AND MAGNETOSPHERE INTERACTIONS
C. T. Russell (California Univ., Los Angeles), J. H. Allen (Environmental Data Serv., Boulder, Colo.), D. P. Cauffman, J. Feynman (Boston Coll.), E. W. Greenstadt (TRW Systems Group, Redondo Beach, Calif.), R. E. Holzer (California Univ., Los Angeles), S. M. Kaye (California Univ., Los Angeles), J. A. Slavin (California Univ., Los Angeles), R. H. Manka (NSF), G. Rostoker (Alberta Univ., Edmonton) et al *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 346-364 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

N80-24705*# California Univ., Los Angeles. Dept. of Earth and Space Sciences.
THE MAGNETOSPHERIC ELECTRIC FIELD AND CONVECTIVE PROCESSES AS DIAGNOSTICS OF THE IMF AND SOLAR WIND
Stanley M. Kaye *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 375-384 refs (For primary document see N80-24678 15-42)
(Grants NsG-7295; NGL-05-007-004; NSF DES-74-23464)
Avail: NTIS HC A99/MF A01 CSCL 03B

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N80-25268*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HIGH TIME RESOLUTION OBSERVATION OF THE TRANSIENT EVENT OF 5 MARCH 1979
M. C. Weisskopf, W. Darbro, P. Ghosh, P. G. Sutherland (McMaster Univ.), and J. Grindlay (Center for Astrophysics) Mar. 1980 8 p refs
(NASA-TM-78273) Avail: NTIS HC A02/MF A01 CSCL 03B

The detection of an intense gamma ray burst with the monitor proportial counter on the HEAO 2 spacecraft is discussed with particular emphasis on the measurement of the time of onset of the event. Based on the mean observed counting rate in the burst and assuming a sharp rise, the uncertainty in the burst onset is found to be + or - 220 microseconds. The time of occurrence was 57124.826908 + or - 0.000220 s UT on March 5, 1979, and the location of the HEAO 2 satellite at this time was latitude 22.15 deg, longitude -27.60 deg at an altitude of 525.0 km. M.G.

N80-25269*# Alabama A & M Univ., Normal.
THE ELECTRIC POTENTIAL OF PARTICLES IN INTERSTELLAR SPACE RELEASED FROM A NUCLEAR WASTE PAYLOAD Progress Report, Jul. 1979 - Feb. 1980
Alton C. Williams Feb. 1980 45 p refs
(Grant NsG-8068)
(NASA-CR-163149; AM-PHY-201-01) Avail: NTIS HC A03/MF A01 CSCL 03B

Mechanisms for charging a grain in the interplanetary medium include: (1) capture of solar wind electrons; (2) capture of solar wind protons; (3) ejection of electrons through the photoelectric effect due to the solar radiation; (4) escape of beta particles from beta emitters in the grain; and (5) escape of alpha particles from alpha emitters in the grain. The potentials on both nonradioactive and radioactive grains are considered with relation to particle size and time, and the distance from the Sun. Numerical results are presented where the waste mix is assumed to be PW-4b. A.R.H.

N80-25270# Air Force Geophysics Lab., Hanscom AFB, Mass.
THE ENERGY SPECTRUM OF COSMIC RAY IRON NUCLEI AND THE PREDICTED INTENSITY VARIATION DURING THE SOLAR CYCLE WITH APPLICATIONS FOR THE INTENSITY OBSERVED BY A MAGNETOSPHERIC SATELLITE Final Report, 1 May - 30 Sep. 1979
W. R. Webber and S. M. Yushak Nov. 1979 29 p refs
(AF Proj. 7601)
(AD-A082223; AFGL-TR-80-0056) Avail: NTIS HC A03/MF A01 CSCL 04/1

This report surveys existing measurements of cosmic ray iron nuclei, combines these data and represents them as a function of modulation during a solar cycle. This composite cosmic ray iron nuclei spectrum is then applied to estimate the heavy nuclei flux exposure to a satellite orbiting at 3.5 Earth radii taking into account the effects of geomagnetic shielding. GRA

N80-24708*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PREDICTION OF ENERGETIC PARTICLE DISTURBANCES
G. A. Paulikas (Aerospace Corp., Los Angles, Calif.), D. N. Baker (LASL), W. R. Barron (AFGL), V. Domingo (European Space Technol. Center, Noordwijk, Netherlands), P. R. Higbie (LASL), W. L. Imhof (LMSC, Palo Alto, Calif.), L. R. Lyons, R. L. McPherron, E. C. Roelof (APL/JHU, Laurel, Md.), M. Scholer (Max-Planck-Inst. fuer Phys. und Astrophys., Munich, West Germany) et al *In* NASA. Marshall Space Flight Center Solar-Terrest. Predictions Proc., Vol. 2 Dec. 1979 p 415-432 refs (For primary document see N80-24678 15-42)
Avail: NTIS HC A99/MF A01 CSCL 03B

99 GENERAL

N80-25271 Engineering Sciences Data Unit, London (England).
ENGINEERING SCIENCES DATA UNIT INDEX, 1979 - 1980
1979 440 p
(ESDU-INDEX-79-80; ESDU-INDEX-77-78) For information on availability of series, sub-series and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $20.00

Contents: introduction and guide for use; current constitution of technical committees; complete sub-series and section list; index; table 1 - physical properties of pure compounds; table 2 - physical properties of elements; table 3 IDS(B): thermodynamic properties of aqueous organic systems. ESDU

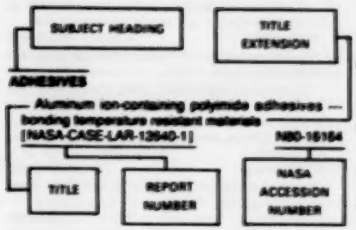
N80-25272# Air Force Systems Command, Washington, D.C.
AIR FORCE SYSTEMS COMMAND RESEARCH PLANNING GUIDE (RESEARCH OBJECTIVES)
1 Feb. 1980 379 p Supersedes AFSC-TR-78-01
(AD-A082043; AFSC-TR-80-01; AFSC-TR-78-01) Avail: NTIS HC A17/MF A01 CSCL 15/3

The purpose of the Air Force Systems Command research planning guide (Research Objectives) is to identify research needed by the Air Force. The document provides a method of informing military and civilian research and development communities of mid-term requirements and of long-term requirements directed toward scientific opportunities which offer the greatest potential for impacting on future military operations. Research must also take advantage of new situations and new opportunities to open up wide areas of technology. One such opportunity is the tremendous potential for technology expansion resulting from the space shuttle development and operational deployment. Increased emphasis is being given to those research opportunities which exploit the unique space shuttle capabilities. In addition, new subareas have been added to the Life Sciences and Weaponry technical areas to add emphasis to an Air Force need for new efforts in environmental quality and civil engineering research. GRA

N80-25273# Finnish National Committee of COSPAR, Otaniem.
SPACE ACTIVITIES IN FINLAND IN 1978 Annual Report
M. Tiuri, ed. and S. Urpo, ed. 1978 11 p refs Prepared in cooperation with Helsinki Univ. of Technology, Espoo
Avail: NTIS HC A02/MF A01

Finnish space programs completed in 1978 or in progress are reviewed. These include soil mapping, land use mapping, and terrain analysis all from LANDSAT data as well as forest mapping, small scale mapping, and ore prospecting (aircraft scanner data). Finnish involvement in the Intelsat, Eutelsat, Sirio, and OTS satellite programs is also discussed. The work of Finnish satellite tracking, telemetry, and acquisition facilities is covered. Author (ESA)

Typical Subject Index Listing



The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7050).

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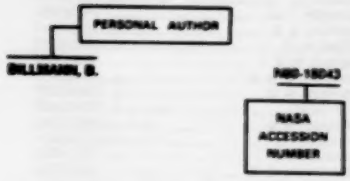

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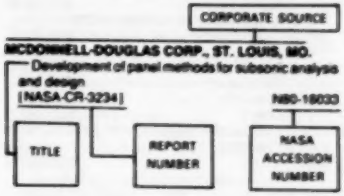

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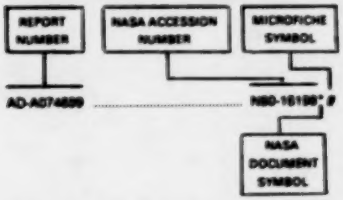

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LPS-79-7 N80-25016 #

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LR-29168 N80-24377 #
LR-29252 N80-25105* #
LR-29382 N80-25105* #

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NASA-CASE-LEW-13268-1 N80-24819* #

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NASA-TM-81825 — N80-24265* #

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NATICK/TR-80/012 — N80-24283 #

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NBSIR-79-1922 — N80-24365 #
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NOR-79-89 — N80-24307 #

NOSC/TR-514 — N80-24532 #

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NR79H-87 — N80-24327 #

NSF/RA-79-270 — N80-24577 #
NSF/RA-790296 — N80-24504 #

NSF/SIU-79-1 — N80-25197 #

NSR-3-15 — N80-24812* #

NSWC/DL-TR-3789 — N80-24734 #

NSWC/TR-79-390 — N80-24371* #
NSWC/TR-79-447 — N80-24667 #

NTIA-79/25 — N80-24547 #
NTIA-79/26 — N80-24548 #

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NTIS/PS-78/0249 — N80-24459 #
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NTIS/PS-79/0219 — N80-24459 #

NTPSC/WP-79-14 — N80-24901 #
NTPSC/WP-79-37 — N80-24503 #

NTSB-AAR-80-2 — N80-24279 #

NUREG-CR-1009 — N80-25072 #

NUSC-TR-6191 — N80-24531 #

NWC-TP-6062 — N80-24799 #

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ORC-79-16 — N80-25081 #

ORNL-5439 — N80-24471 #
ORNL-5809 — N80-25107 #

ORNL/NUREG/TM-349 — N80-25072 #

ORNL/OIAPA-13 — N80-25125 #

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ORO-5126-97 — N80-25127 #
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ORO-5759-T1 — N80-24866 #

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OWRT-A-047-ME(1) — N80-24895 #
OWRT-A-083-SOAK(1) — N80-24739 #
OWRT-A-101-MICH(1) — N80-24892 #

OWRT-B-078-RI(1) — N80-24891 #

OWRT-C-80011-S(8512)(1) — N80-24410 #

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PB80-128956 — N80-24876 #
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PB80-128150 — N80-24409 #
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PB80-145055 — N80-24974 #
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POLY-MRI-1403-79 — N80-24529 #

PQTR-1046-79-5 — N80-25193 #

PR-3 — N80-24884 #
PR-517 — N80-25219

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